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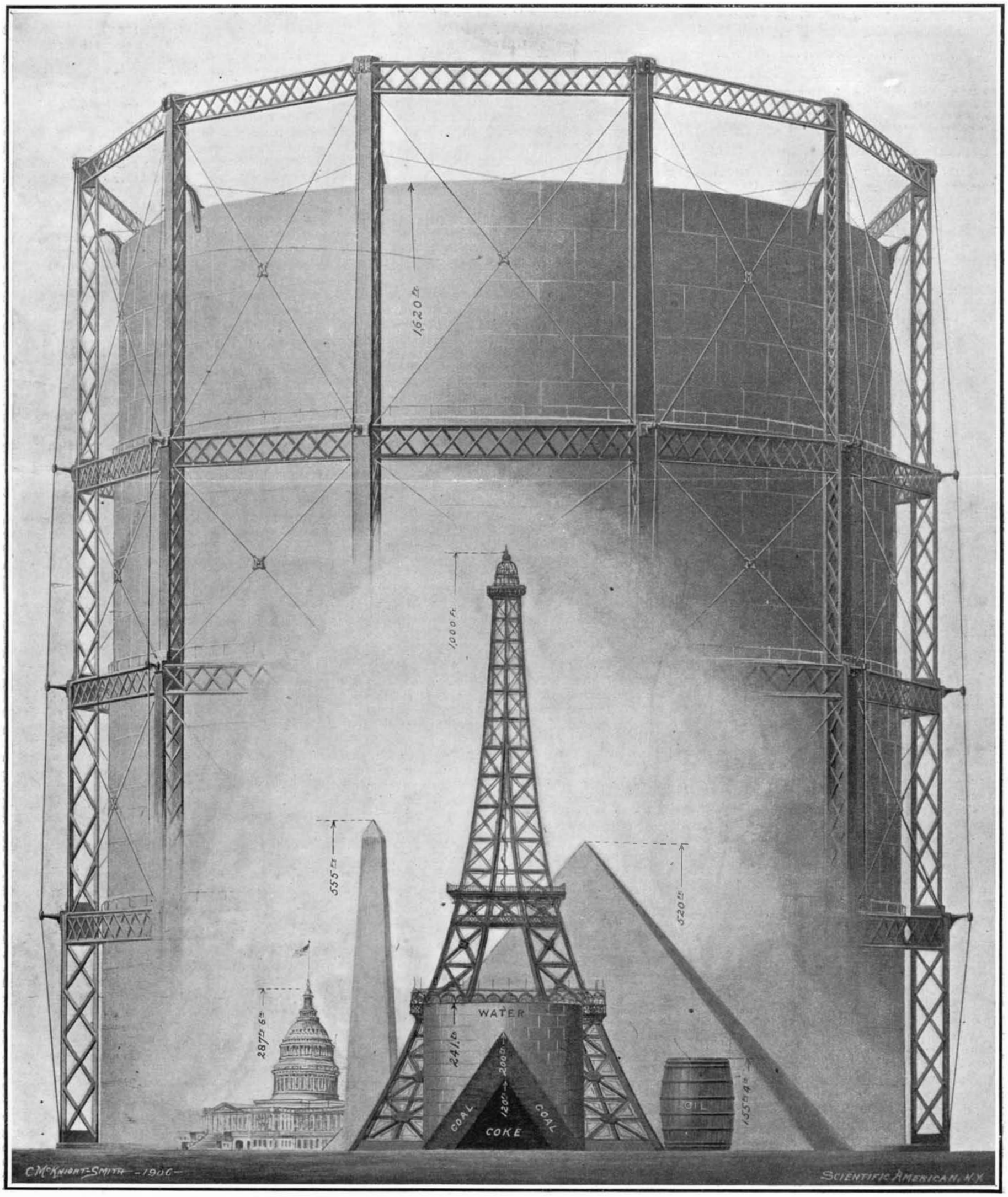

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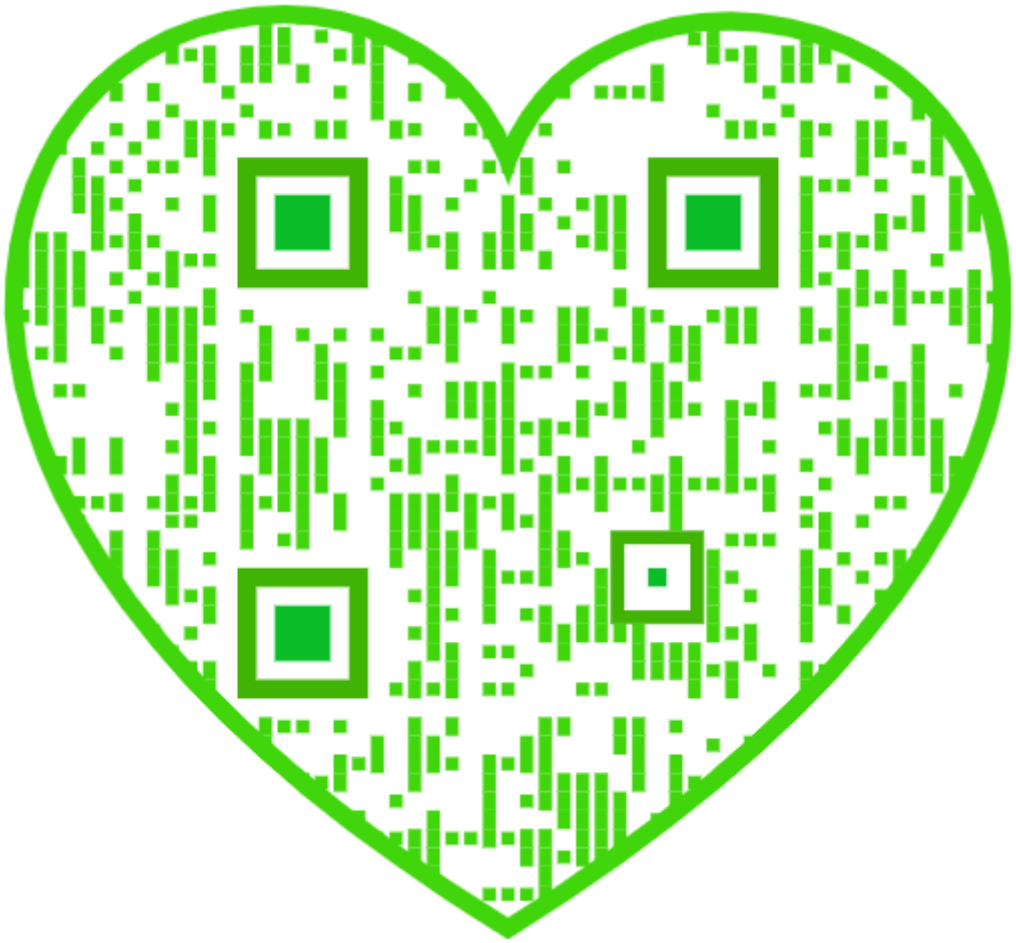
THE MAGNITUDE OF THE GAS INDUSTRY.—[See page 190.]



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ESTABLISHED 1845

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NEW YORK, SATURDAY, MARCH 2, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

RISKS OF STEEL-CONCRETE CONSTRUCTION.

A serious risk, which is none the less threatening because it is altogether unnecessary and preventable, exists in the new system of concrete-steel construction which is entering so largely into modern work. Its cheapness, its apparent simplicity of design, the ease with which its materials may be assembled and the speed with which they can be thrown together into the finished work, have combined to render this new form of construction extremely popular. The peril lies in the supposed simplicity of the design and in the ease and speed with which concrete-steel structures can be built. To these two causes chiefly, and generally to the latter, may be assigned the failures of concrete buildings, which of late have become alarmingly frequent

Let it be understood then, in the first place, that it is not a simple matter to properly design the posts, beams, girders, and floors of a concrete building; that is, to design them so as to secure a maximum amount of strength with a minimum amount of material. It is not nearly so simple a matter as to design a building composed of a structural steel skeleton, with tile, concrete, or masonry floors and walls. Concrete-steel construction, in the present state of the art, is scarcely out of its infancy. In spite of the fact that it has been made the subject of much laboratory and testing yard experiment, the sum total of clearly ascertained and reliable data is not large. So true is this that there are few classes of work that come within the engineer's or architect's province, in which he is called upon to exercise such excellent judgment and to apply so carefully the facts and principles of his profession, as in concrete-steel construction. However, it is not here that the chief peril lies; not at least when reputable engineers of standing in their profession are employed. It is when the plans are handed over to the builder with his gangs of cheap labor that the trouble begins. For unless the foreman or assistants, whose duty it is to watch the actual laying and ramming of the concrete, are careful and intelligent in their oversight, it is possible for the work to be so carelessly done as to greatly impair its strength, if not to make certain its ultimate collapse. The steel bars which reinforce what might be called the lower chord of a concrete girder, or the exterior shell of a column, lose their value unless the concrete is everywhere so snugly rammed against them, as to throw them into intimate stress relation with the girder or column as a whole. "Eternal vigilance" should be the watchword of the future, if this new form of construction is to regain the reputation for combined cheapness and strength, which has been so severely imperiled by the many failures of the past few months.

SHOULD SURFACE SOIL BE STRIPPED FROM RESERVOIRS?

In connection with the plans of the new Catskill reservoirs by the New York Board of Water Supply, the question arose as to whether it would be advisable to strip the surface of the ground which will form the bed of the big Ashokan reservoir of all vegetation and surface soil, with a view to securing a better quality of water. The practice of stripping is advocated by the hydraulic engineers of Massachusetts, and the most notable instance of carrying out this costly method of securing pure water is to be found at the Watchusets reservoir, which impounds over 60 billion gallons of water and forms the main source of the Boston water supply. The new Ashokan reservoir will have a capacity of 140 billion gallons; and the New York Board of Water Supply, having in view the great expenditure which would be necessary to strip the bed of the reservoir, referred the whole question to a board of two engineers, who have lately presented an exhaustive report, in which it is shown that while there are undoubted advantages in the practice of stripping, a more effective method of purification is to be found in the construction of filtration plants, through which all the water must pass in its course from the reservoirs to the city's faucets. Moreover, in spite of the most careful safeguards, it has proved to be impossible to absolutely prevent infection of the watersheds from which reservoirs are filled, and it has come to be recognized that the only effective way to attack the problem is by interposing a filtration plant between the open-air reservoirs and the city to be served, which will not only remove all bacteriological impurities, but also those which are due to submerged and decaying vegetation.

THE "MIKASA" WAS SUNK BY SPONTANEOUS MAGAZINE EXPLOSION.

The loss of Admiral Togo's flagship "Mikasa," as the result of an internal explosion, was one of the most startling events of the Japanese war; and the tragical atmosphere which surrounded the catastrophe was deepened by the fact that the "Mikasa" was more strongly associated in the minds of the Japanese people with the triumphs of the war than any other ship in their navy. Moreover, there was a sinister rumor, rather industriously circulated, that the loss of the ship was the work of discontented Japanese sailors. To at once clear the navy of any such imputation, and solve the mystery of her loss, the Japanese Admiralty made an immediate investigation by means of divers, who reported that no trace could be found of misconduct or neglect on the part of the officers or men, the explosion having originated in the port magazine containing 6-inch ammunition. When the vessel was recently refloated, the Naval Department appointed another committee, whose investigations have shown that the explosion resulted from spontaneous combustion, due to a chemical change in the ammunition of the 6-inch magazine. That smokeless powder has always been, and, in some of its forms, is yet, liable to dangerous decomposition while in storage, is well known, and it is more than likely that other serious warship explosions and disasters may have been due to this sinister and at one time greatly-dreaded cause.

THE PERIL OF THE ELECTRIC LOCOMOTIVE ON STEAM ROADS.

In asserting that unless special precautions are taken the introduction of electric locomotives on steam roads is fraught with great peril, we wish to make it clear that the statement is applied to the electrification of steam railroads in general, in whatever part of the world the change of power may be taking place. We have no wish to cast any special reflection upon the railroad upon whose tracks occurred the shocking derailment disaster of last week. Indeed, considerations of fair play should lead us to bear in mind that the very roadbed on which the accident took place represents the most advanced ideas in track construction in America, and for that matter, in the world. It consists of 100-pound rail with tie plates between rail-base and ties, and from 12 to 18 inches of broken stone ballast laid upon a well-drained foundation. That the track was well adapted to its work of carrying heavy, high-speed steam trains is shown by the fact that some of the fastest trains in the world, drawn by the heaviest express locomotives in existence, have for years been running daily over the particular curve where this accident occurred, without any trouble whatever. Some of these expresses are made up of nine cars, weighing over 500 tons, and hauled by an engine that weighs about 170 tons. Yet, on the present occasion, although the train was a light one, consisting of five cars of about 200 tons combined weight, hauled by two locomotives weighing together 190 tons, the outer rail was pushed bodily aside, and the train back of the engines derailed.

Evidently there existed in the ill-fated train some novel conditions which were sufficient to cause the wreck, and one does not have to look very closely into the matter to find ample evidence that the new conditions were to be found in the heavy concentrated weight and low center of gravity of the electric locomotives, and the enormous horse-power, between 6,000 and 7,000, which the motorman had at command. It is our belief that this disaster should call an immediate halt upon the application of heavy electric locomotives to steam roads, until the tracks at all curves have been put into a condition to meet the heavier stresses which will be imposed by the higher speed, the concentrated wheel loads, the rigid wheel base, and the very low center of gravity of the electric locomotives. The express steam locomotives of the New York Central Railroad have a maximum horse-power of about 1,700, whereas the electric locomotives of the same road have developed a maximum of over 3,000 horse-power. Of course, it is not intended that this maximum shall be used, except in emergency cases in which unusually heavy loads must be hauled at the highest speed. Yet it will inevitably occur in future electric operation, that an engineer will occasionally be behind time during a trip on which he has a light train behind his powerful motor, and he would not be human if he did not feel the strongest inducement, having such an enormous reserve power at his command, to open his controller and make up, as he could easily do, the lost time. But at these excessive speeds (and they will inevitably be made, in spite of all that the management of the road may do to prevent it) the trains will be running at a velocity far greater than that for which the outer rails on the curves have been banked or elevated, and when that condition is reached, the peril of displaced or overturned rails begins to loom up very big and threatening.

The danger of derailment through excessive speed is aggravated by the fact that the center of gravity of an electric locomotive lies very much lower (nearer the rail) than that of the steam locomotive. Consequently, the impact or surging of the locomotive against the outer rail, the hammer blow, as we might almost call it, would be much more severe for the same weight than in the steam locomotive. The center of the steam boiler of the present expresses on the New York Central road is about 9 feet 6 inches above the track, and when the engine lurches against the outer rails of a curve, there is something of a cushioning effect due to the fact that the weights are relatively high. But in the electric locomotive, the heavy motors are placed concentrically around the axles, the wheels are small in diameter, and the massive frame is hung low, with the result that there is a heavy concentration of weight near the rails. Moreover, the heavy rotors are fixed rigidly upon the axles. Taken altogether, it can be seen that the lateral hammering effect against the outer rail must be very much more severe in the electric than in the steam locomotive. Furthermore, about 70 tons out of the 95 tons total weight of the locomotive is concentrated on the four drivers and within a space of only 12 feet. This wheel base of the drivers is rigid, and must necessarily act with an intense local side thrust against the particular rail over which it is moving; nor did that rail in the case of the recent accident receive any assistance from the rail behind it, since this rail also was subjected to similar stress from the second locomotive.

There is no cause for wonder that in their attempt to iron out the curve into a tangent, these motors so far succeeded as to shear off eighteen spikes and push the outer rail several inches out of place—even though this shearing called for a lateral thrust of one hundred and twenty-four tons, exclusive of the thrust necessary to overcome the frictional resistance to side movement of the base of the rail on the tie plates. Such a side thrust, however, should have turned the motors over. But they did not turn over, and hence it is certain that the leading wheel of the drivers "ironed out" the curve, with a lateral wave motion which sheared the spikes in succession—as we have shown elsewhere in this issue.

The moral of this disaster points to the absolute necessity for a complete revision of the tables for super-elevation of outer rails on curves on steam railroads to meet the heavier stresses engendered by electric locomotives. The lavish expenditure of the New York Central Company in providing its electrical equipment should be sufficient evidence that the disaster is not due either to parsimony or to indifference. It was the belief of the engineers that the elevation of the rails was sufficient. Events seem to prove that it was not.

The New York, New Haven & Hartford Railroad Company are also about to install their electric service, in which, because of the low power (about 1,200) of their motors, they will be under the necessity of coupling up two locomotives (each weighing 80 tons) for their heavy expresses. They must therefore subject their curves every day to the trying conditions of double headers, which some missing contact shoes on one motor necessitated in the case of the ill-fated New York Central Express. Therefore we commend to the thoughtful consideration of the New Haven officials the proposition that both the safety of the public and the interest of their company demand that, before these double-header electric trains are put in service, every curve should be super-elevated to a degree commensurate with the conditions of high centrifugal stress, revealed by the eighteen sheared spikes and misplaced rail in the recent disaster.

According to L'Elettricita, it has been agreed between the Oerlikon and the Siemens-Schuckert works to commence immediately the plant for the electrification of the whole length of the St. Gothard Railway. The section from Zurich to Lucerne is to be constructed first as an experiment. This first section is the only one at present approved of by the Federal Railway Department, but it is stated that a syndicate has offered to convert at their own cost the whole part of the line which is situated in Switzerland by 1909, and to transfer it to the Swiss government on terms yet to be agreed upon.

THE HEAVENS IN MARCH.

BY HENRY NORRIS RUSSELL, PH.D.

Though the activity of the solar surface is now decreasing from the maximum of a year ago, large spot groups from time to time appear. A very conspicuous one has just passed out of sight behind the eastern limb of the sun, and if it does not break up or disappear in the meantime, it will come into sight again on the opposite side of the sun about the 3d of March and remain in sight till the 16th.

This group was visible without difficulty to the naked eye when a suitable shade glass was used, and showed considerable detail in a field-glass. In using the latter to look at sun-spots, it is well to put the smoked glass between the eyepiece and the observer's eye, and it is of course essential to take care that the intense light passing through the other half of the instrument does not fall on the observer.

A great amount of work has been done on sun-spots and their spectra during the recent maximum, and some very interesting results have already been published. Among them is an important discussion by Prof. Heale and several of his assistants at the new Solar Observatory on Mount Wilson, Cal.

Their observations, like those of many earlier observers, show that the spectra of sun-spots, while in general similar to that of the rest of the sun's surface, differ in many details. Some lines are widened and intensified, others are weakened, and some are even reversed, appearing bright in the spot although dark elsewhere. Of the lines belonging to some one element, such as iron, some will be affected in one direction and others quite in the opposite way, so that the changes are clearly not due to any difference in the chemical composition of the material of the spots and of the rest of the sun's surface.

Now these same lines are seen (bright in this case) when the metal in question is put into an electric arc, and the astronomers of the Solar Observatory, comparing photographs taken under varying conditions, find that if we compare the spectra of two arcs containing the same metal, but produced in one case by a powerful current and in the second by a very weak one, the various lines are affected in almost exactly the same way, on changing from the strong to the weak current, as in passing from the sun's surface to a sun-spot.

In the case of the two arcs, it is pretty clear that the principal difference between them is in their temperature. The stronger current produces much more heat. This conclusion has been tested in a variety of ways, and it seems certain that in the laboratory the observed changes in intensity of the different lines are due to the changes in temperature of the luminous matter.

Now the changes of the lines in the sun are almost exactly similar, and so it is reasonable to conclude that sun-spots are colder than the rest of the sun's surface. This accounts at once for their relative darkness, and also for the fact that their light, if isolated, is much redder than that of the sun in general. They behave exactly as a red-hot body in front of a white-hot one would do (though it is to be remembered that the coldest part of a sun-spot is probably fully as hot as the hottest electric furnace we can produce artificially).

It does not follow because sun-spots are colder than the rest of the sun, that the sun as a whole sends us least heat when it is most spotted. All spots are surrounded by a disturbed area much larger than themselves, and this may be hotter than the undisturbed surface, and more than make up the loss of heat due to the spot. In any case the total effect is probably very small, as spots seldom, if ever, cover as much as 1/300 of the sun's disk.

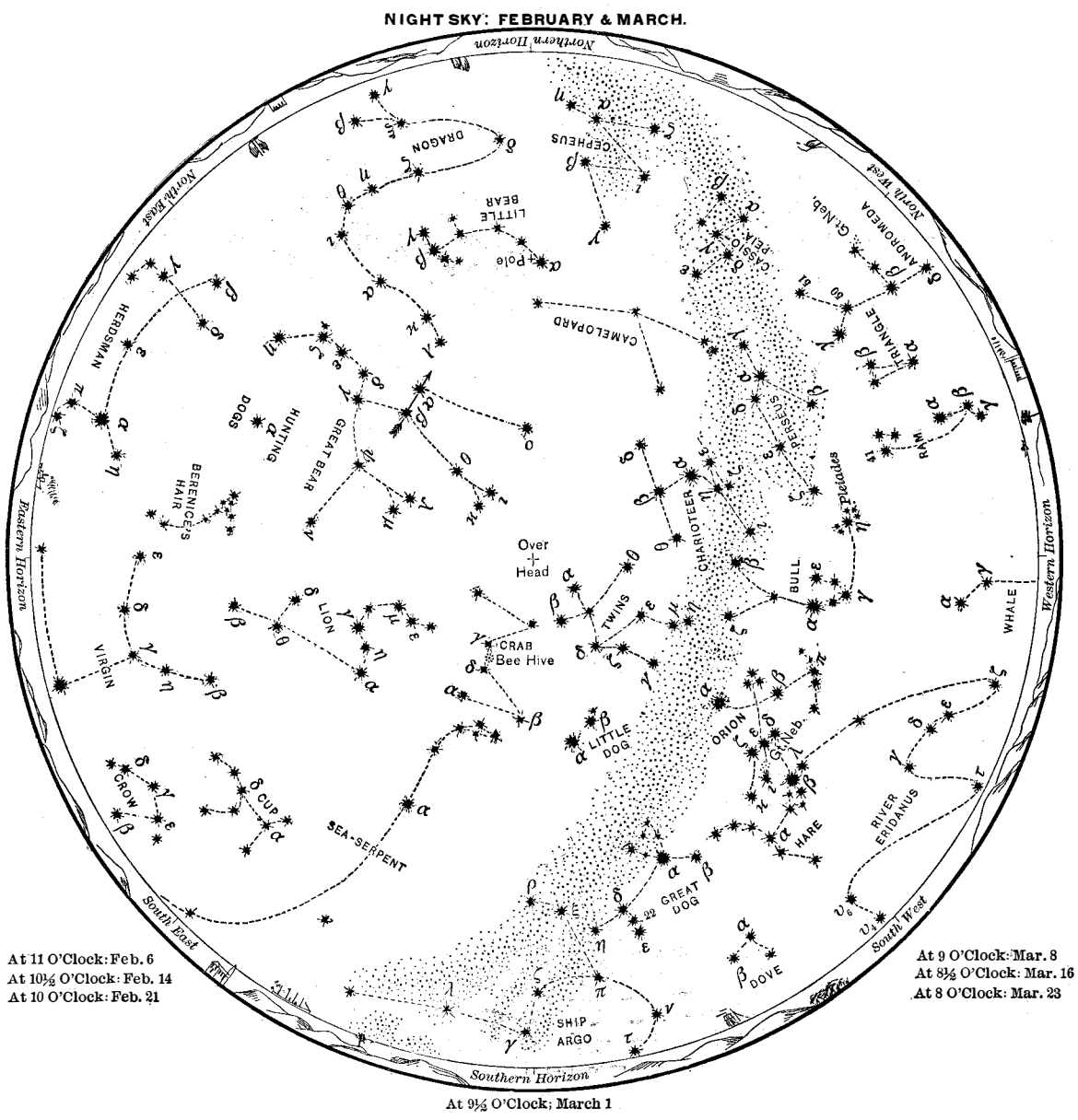
There is undoubtedly a connection between sun-spots and certain electrical disturbances on the earth; namely, the "magnetic storms," which may alter the direction of the compass needle by half a degree, and cause such earth-currents as to interfere with the working of telegraph lines. But whatever the mechanism of the connection (which is still unknown) it is not an infallible one. When sun-spots are most numerous magnetic storms and auroras are most frequent, but it is not certain that any particular big spot will be accompanied by a magnetic storm, though this often happens.

THE HEAVENS.

Our map shows the principal constellations as they appear in the early evening. The Milky Way forms a slanting arch across the sky, passing west of the zenith. Following it from the north we see Cepheus, then Cassiopeia, next Perseus, and Auriga (the Charioteer), then Gemini (the Twins), and Orion, and finally Canis Major (the Great Dog) and Argo on the southern horizon. In the west are Andromeda, Taurus, Aries, and Eridanus, with all of which we are familiar.

In the southeast is most of Hydra (the Sea-serpent), which incongruously bears on its back the Cup (Crater) and the Crow (Corvus). Leo the Lion is high in the east, and below him is Virgo, whose brightest star Spica has just risen.

The Great Bear fills a large part of the northeastern sky. Below on the right is the single bright star of the Hunting Dogs, and the little cluster of Berenice's Hair. Still lower is Bootes the Herdsman, whose principal star Arcturus has just risen. The Dragon and the Little Bear, low in the northeast, complete our list.



In the map, stars of the first magnitude are eight-pointed; second magnitude, six-pointed; third magnitude, five-pointed; fourth magnitude (a few), four-pointed; fifth magnitude (very few), three-pointed; counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

THE PLANETS.

Mercury is evening star until the 18th, when he passes between us and the sun and becomes a morning star. He is very well placed for observation at the first of the month, being unusually bright, and setting one and one-half hours later than the sun. In the middle of the month he is invisible, but toward the end he may be visible just before sunrise.

Venus is morning star in Sagittarius and Capricornus, and rises about 4:30 A. M. on the 15th.

Mars is also a morning star. On the 9th he is in quadrature with the sun, and comes to the meridian at 6 A. M. Jupiter is in Gemini, conspicuous in the evening sky. He is also in quadrature during the month—on the 23d—but being east of the sun he crosses the meridian at 6 P. M. Saturn is in conjunction with the sun on the 8th, and is invisible.

Uranus is in Sagittarius, and rises at about 3 A. M. on the 15th. Neptune is in Gemini, and is in quadrature on the 31st.

THE MOON.

Last quarter occurs at 4 A. M. on the 7th, new moon at 1 A. M. on the 14th, first quarter at 8 P. M. on the 21st, and full moon at 3 P. M. on the 29th. The moon is nearest us on the 9th, and farthest off on the 21st. She is in conjunction with Mars on the 7th, Uranus on the 9th, Venus on the 10th, Saturn on the 13th, Mercury on the 14th, Jupiter on the 21st, and Neptune on the 22d.

At 1 P. M. on the 21st the sun crosses the celestial equator and enters the sign of Aries, and in almanac language, "spring commences."

Princeton University Observatory.

PEARLS FROM THE SULU SEA.

The possibilities of pearl fishing in the Sulu Sea seem unlimited. The greatest pearl ever claimed from the sea in the Sulu archipelago was recently marketed in Singapore for 60,000 pesos (nearly $30,000). It is the size of a small marble, perfectly round and of perfect color. The finding of the gem by a poor Moro fisherman, its seizure by the Sultan of Sulu, and the interference of Gov. Steever, who took the part of the poor fisherman, is an interesting incident.

Under the old Moro law, in force when the American troops first took charge of Jolo, all pearls of unusual size must be sent to the Sultan, who in return made the finder a "present." The only alternative the finder of a large pearl had was to sell his treasure privately to the pearl traders. This placed his life in jeopardy, for if the trader could not buy the gem at his own price he could report the matter to the Sultan, who had the power to seize the finder and execute him. Under American rule, however, this law has been abolished. The finder of this $30,000 pearl knowing this fact, when his find was seized by the Sultan, he speedily made a trip to Jolo and reported the matter to Gov. Steever. The matter was taken to court, and the Sultan forced to give up the pearl. The Governor commissioned the Jolo Trading Company to sell the pearl for the finder, they receiving twenty per cent for so doing.

So far as known this pearl is the largest ever taken from the Sulu Sea, though owing to the secrecy practised in selling the gems before American rule in Sulu, there may have been greater finds. Three years ago a pearl found somewhere to the south of Jolo was carried to Batavia, and there sold to a European buyer for $18,000.

During the recent fair at Jolo, given by the government for the purpose of bringing the Moros together, Capt. Trana, of the Jolo Trading Company, exhibited a magnificent black pearl valued at $7,000, a rare gem of unusual size and beauty.

LIGHT AND BLOOD.

According to a notice published in the German medical press, Dr. Oerum, of the Finsen Institute at Copenhagen, has just carried out a number of experiments on the effect of light on the blood, of which a few results are given in the following:

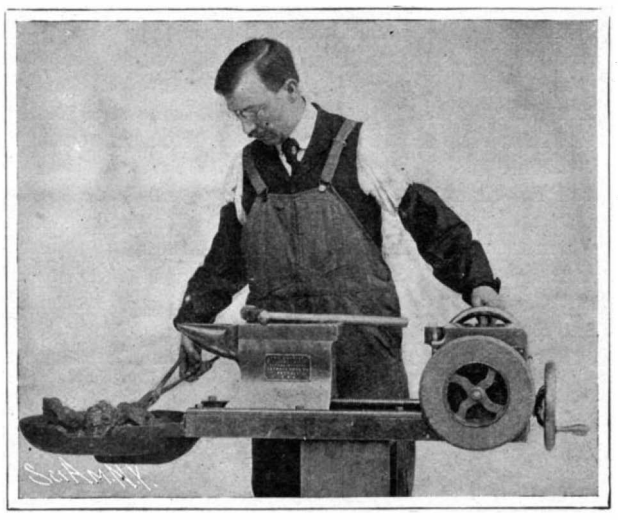
Darkness has been found to reduce the total amount of blood by 3 to 3.3 per cent, while decreasing at the same time the amount of blood contained in the heart. Red light will exert a similar action to darkness, while blue light is apt to result in an excess of blood, and an increase in the amount contained by the heart. Light baths are apt to increase the amount of blood in the course of four hours. Darkness will reduce the amount of blood contained in the heart within three to four weeks, and intensive light will have the same effect in four hours. Darkness will increase, and intensive light will reduce the blood pressure. Animals born in the dark or in red light have a greater weight but only half the amount of blood of those born under normal conditions.

A USEFUL COMBINATION TOOL.

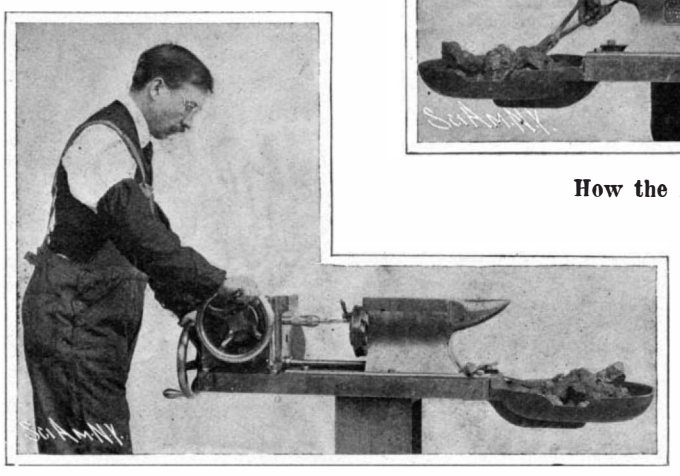
BY A. FREDERICK COLLINS.

The farmer, the automobilist, and the householder frequently have occasion to make repairs, sharpen plow points, cultivator shovels, and the like. Often the parts to be repaired must be sent to the machinist or the blacksmith for lack of proper tools. Much time and money could be saved by using some combination machine tool, uniting in itself the various implements required from time to time. It is this purpose which the tool herewith illustrated is intended to meet. This tool contains in a single unit a workshop complete in every detail, and at a cost hardly exceeding that of an ordinary hand forge. This tool combines on a single base, or bed-piece, a pipe vise, an anvil, a forge, bench vise, drill press, and emery wheel. It is made in two sizes, the smallest and lightest weighing 135 pounds, and the largest and heaviest 200 pounds, the latter having a length of 50 inches over all, a width of 10 inches, and a height of 12 inches.

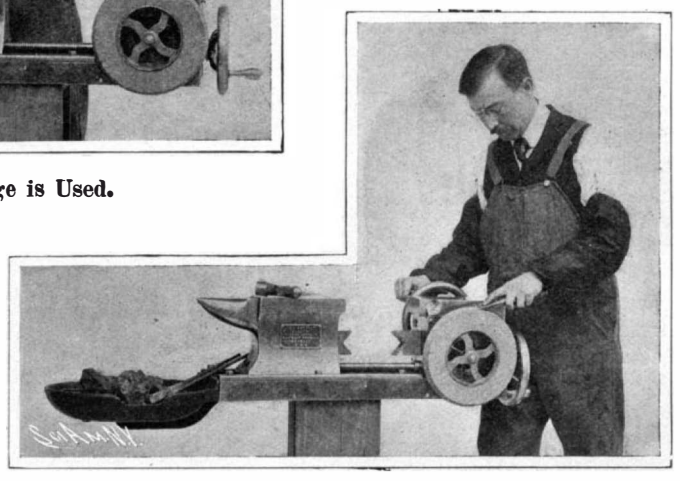
The tool, for the purpose of explaining its construction, may be divided into three general parts, namely, the headstock, the anvil, and the forge. The forge has a fire-pot 14½ inches in width and 16 inches long, the air being supplied by a rotary blower located in the headstock. The air is delivered to the center of the forge through a channel in the base-plate. The fan shaft of the blower projects through the air intake at the front side of the gear case, and is fitted to receive an emery wheel, the intake being so placed that the draft of air draws the emery dust into the forge and away from the operator. The fire is started in the forge exactly as it is in an ordinary stove.



How the Forge is Used.



Drilling a Piece of Work.



The Emery Wheel in Operation.

The blower and emery wheel are operated by a crank wheel located on the rear side of the gear case. The rotary jaw and emery wheel are geared in the ratio of 12 to 1, so that they can be revolved by hand at a speed of 2,000 revolutions per minute. The emery wheel is 10 inches in diameter. An emery wheel, as everyone knows that handles tools, is a vital necessity in a shop, since all edged tools can be sharpened not only better but in far less time than on an old-time grindstone.

The drill press is fitted with a Barber adjustable chuck taking drills to ½ inch; it is geared 2 to 1, giving great power and speed. The socket for receiving the chuck is driven by gears incased in the headstock; the gears are supplied with a clutch mechanism, enabling them to be thrown in and out of mesh at the will of the operator. The work to be drilled is placed across the face of the tailstock, and forced up as the drill is cutting by means of the vise screw.

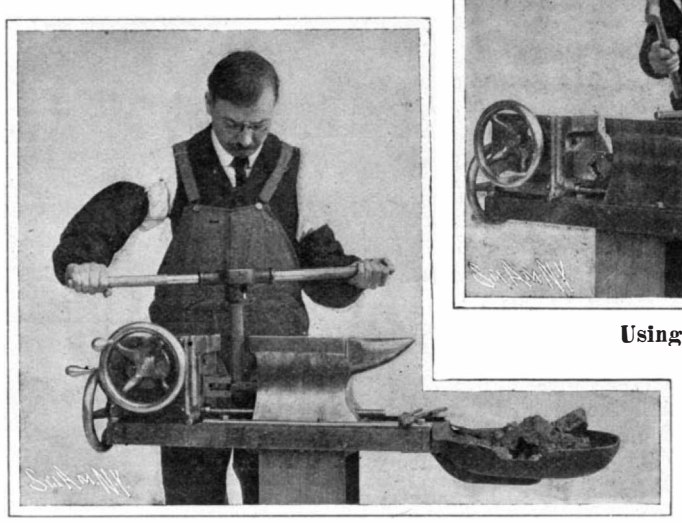
When work is to be drilled, the operator takes his position at the headstock of the tool, and grasping the crank handle with his right hand, he feeds the drill with his left. The power obtainable with the feed wheel is so easily underestimated, that unless care is exercised the result will be a broken drill bit. When using the drill all the bearings should be freely oiled, and when drilling steel the cutting point of the drill should also be plentifully oiled; a hardwood drill block that fits nicely to the end of the anvil should be used when drilling.

The blower, emery wheel, and drill press are operated by a combination crankwheel or driving pulley, so that it can be turned by hand, driven by a motor or from the driving shaft of an automobile. The transmission gears are cut and therefore accurately made, and the large wheels run into phosphor-bronze pinions, making them strong, long-lived, and practically noiseless. The gears are covered, and have a clutch arrangement at the end of the gear case, by which they can be thrown in or out of gear as desired. The anvil is 15 inches over all, 4 inches wide, and 8 inches high.

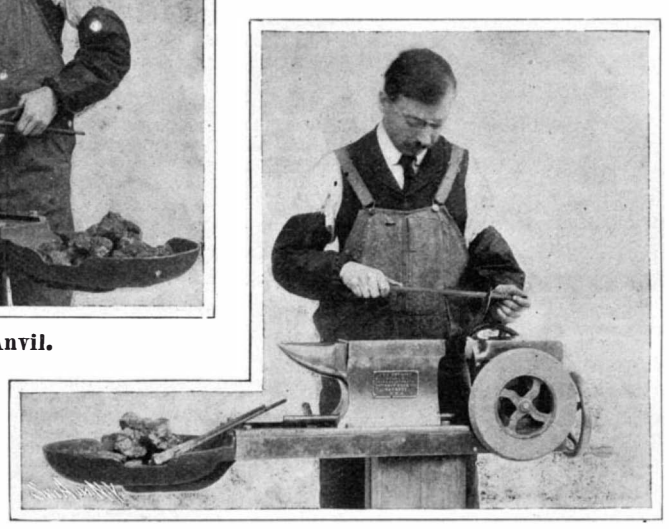
The weakest point in an ordinary vise is the front jaw; in the combination tool the bench vise is without this inherent weakness by virtue of its peculiar construction. As a reference to the cuts will show, the tailstock, which is in this case also the anvil, forms the movable jaw of the vise, which slides on the base between two adjustable guides; the last named are beveled to conform with the bevel on the base of the tailstock. This prevents lost motion, and at the same time prevents strains on the vise jaws and screws. The headstock acts as the stationary jaw. The jaws, which are made of tempered steel, are 4 inches wide and open 10 inches; these are operated by a ⅛-inch square-threaded cold-rolled steel screw fitted with a crank wheel which has a drop-forged steel handle, and holds just as securely when opened to its greatest distance as when closed.

The pipe vise has jaws made of tempered tool steel,

Using the Anvil.



The Tool as a Pipe Vise.



The Anvil and the Head Stock Form a Vise.

A USEFUL COMBINATION TOOL.

and is operated by the same heavy screw as the bench vise; it will securely hold any pipe from ⅛ inch up to 3 inches in diameter, and the jaws can be changed so that the pipe may be held horizontally or vertically as desired, thus enabling the operator to do a wide range of work.

There is also included in the outfit an anvil hardy, that is a square-shanked chisel or fuller, made of tempered tool steel, for insertion in the hardy-hole of the anvil; a crucible holder, being an iron frame that can be placed on the forge over the fire, and useful for holding a crucible, glue pot, or soldering iron; one twist drill, and a pair of 18-inch blacksmith's tongs.

Novel Uses of Peat.

In Germany the uses to which peat has been put are many, and the consumption is constantly increasing. For bedding for stock only the second and third layers of peat are used. The blocks of peat are dried by air or in a kiln; they are then shredded by machinery, and then sieved, after which the peat is compressed and packed in bales by means of slats of wood and iron wire. The amount of bedding necessary per head of cattle is one hundredweight per year for every hundredweight of the animal's weight. Many sanitary and other advantages are derived from the use of this kind of bedding.

For fodder, only the top layer is used, which consists of moss and the fibers of partially-dried parts. The dried peat is then ground and sifted and mixed with molasses in the proportion of 20 to 25 of peat and 70 to 75 of molasses, obtained in the manufacture of sugar from beets. This product is guaranteed to contain 35 to 40 per cent of sugar. This fodder is used either alone or mixed with other food, as corn, potatoes, etc. The peat in this mixture counteracts the laxative effect of the molasses, and in the whole forms a wholesome food for horses, cattle, and swine; and as the acid of the peat seems to neutralize the alkalies of the molasses, the latter are rendered harmless, and the mixture has a sweeter taste than molasses alone. When due precaution is taken, the mixture keeps well. Horses fed with this develop glossy coats, gain in appetite, and are free from colic. Neat cattle are said to become less subject to "foot and mouth disease," and in the case of swine thus fed, that the unpleasant smell of butyric acid disappears from the sty and disease generally diminishes. The addition of 4.4 pounds to the daily feed of milch cows is said to increase the daily yield of milk about 0.55 gallon. In the province of Hanover from 10,000 to 15,000 tons are used every year, while Germany as a whole consumes 150,000 to 200,000 tons.

The value of peat for fuel is shown by the fact that it contains 54 per cent of carbon against 50 per cent in wood, 70 in soft coal, and 83 in hard wood.

The so-called "Torfmull," or turf dust, is sifted out of peat and used for packing fruit, such as tomatoes and other products, while "Mull," a by-product of peat, is used in potash works as a filter.

Owners of cabin power boats should be made cognizant of the danger from fire in the use of jump-spark ignition. Even in open boats a timer on the crankshaft is a potent element of danger. All timers should be on a level with the top of the cylinders, with coils always above the engine or fastened to the washboard, and under no consideration of convenience in a locker or in any other confined space. Manufacturers are becoming alive to this danger, as evidenced by the many engines already designed to use an inclosed timer, that formerly used the less safe system. At the break of the contact there is usually a spark, and if gasoline vapor should happen to be present, mixed with the proper proportion of air, an explosion and fire would result. This is decidedly more likely to happen where the timer is on the shaft, in the lower part of the boat and where it is unprotected by a cover.

THE AUTOGENOUS SOLDERING OF METALS.

BY M. U. SCHOOP.

Notwithstanding that intensely hot blow-pipe flames, particularly the oxy-hydrogen gas flame, have been known and used for many years, it was the last decade which first saw the introduction, on a large industrial scale, of the autogenous soldering of various metals, such as iron, copper, nickel, and aluminium. The attempts to introduce electricity into this branch of metallurgy have, it is true, been numerous; but a general utilization of electrical processes of this character has not been effected, at least in Europe, doubtless because of the numerous disadvantages possessed by

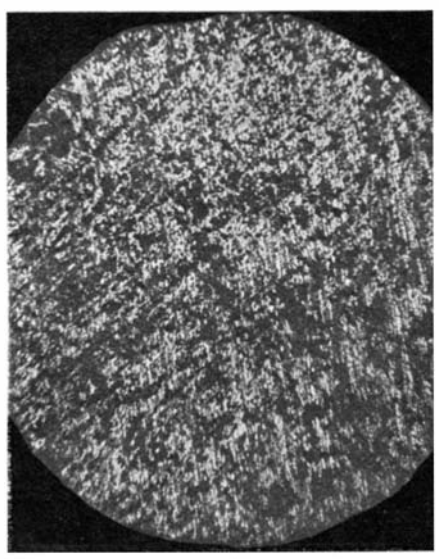


Fig. 1.—Cross-Section Through the Soldered Joint. Greatly Enlarged.

these methods. In the so-called electric arc welding, in which the metal to be welded itself constitutes one pole, while the other pole is formed by a carbon rod which is moved over the welding points, the latter become as hard as glass. With the Zerener apparatus, in which the flaming arc is formed into a jet flame by means of a magnet, the temperature regulation is extremely difficult of accomplishment. Both these processes possess the disadvantage that the eyes and all unprotected portions of the body are strongly affected thereby. The process of Hohe and Lagrange, the so-called "under-water resistance welding method," has not been possible of introduction in practice because it is too expensive and complicated. The well-known Thompson method is also based upon the resistance principle, and is characterized thereby that the pieces to be welded are blunt in form and are so brought into contact that they offer great resistance to the passage of the current. Thus, the desired temperature is obtained in a very short time, whereupon the circuit is opened and the pieces are mechanically forced together under pressure. The disadvantage of this method which, of all the electrical processes, has alone attained practical significance, is the considerable expense of installation. Furthermore, the Thompson process is available for a certain class of welding operations only. This may also be said in regard to the Goldschmidt Thermit welding process.

The above are substantially all the more recent soldering—that is, welding—processes; they are, however, inferior in regard to practicability, facility in operation, and cheapness, to autogenous soldering or welding. An exception to this is found in lead soldering, which can be effected with great ease and at little cost by means of an electric resistance method. Furthermore, the process is cleanly and can be carried out without special technical training or experience; it has been introduced and is used exclusively in a number of French accumulator factories.*

There are several processes for carrying out autogenous soldering, which make use of the combinations given below for the production of the flame:

1. Hydrogen-oxygen.
2. Acetylene-oxygen.
3. Illuminating-gas-oxygen.
4. Hydrogen-atmospheric air (for lead and hard lead).

The existing conditions govern the choice of the flame in each case, but it is to be remarked that where illuminating gas is available, the combination of the latter with oxygen is without doubt the most rational for the usual cases encountered in practice, and in such cases will almost always provide a sufficiently hot flame, which, in its characteristics, closely resembles the oxy-hydrogen flame. If it is a question of metals possessing exceptionally great heat conductivity, as, for instance, electrolytic copper, the acetylene-oxygen flame should be used, as it is possible to provide a temperature of 3,000 deg. C. (5,432 deg. F.) with it, whereas the temperature of the illuminating gas, or hydrogen-oxygen flame, is in the neighborhood of 2,000 deg. C. (3,632 deg. F.) only. These are degrees of heat which practically no material is capable of resisting. Brick, pumice stone, carbide, platinum, are liquefied by means of the acetylene-oxygen flame, and graphite alone can withstand this temperature.

It should be noted that in regard to expense the oxy-hydrogen flame is, in most cases, more costly than the acetylene-oxygen or illuminating gas-oxygen flame. I say "in most cases" advisedly, as various considerations are of importance in the question of operating expense, such as the kind and thickness of the metals

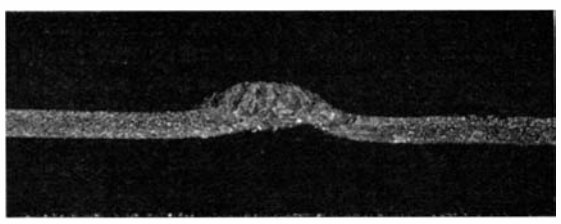


Fig. 3.—Soldered Joint Corroded by Hot Potassium Solution.

to be welded and the local conditions which must be taken into account. In certain cases where repairs are to be made on the spot, the only possibility lies in welding by means of the oxy-hydrogen flame, as the entire apparatus for the latter consists of two steel surfaces, a welding burner, and a few yards of tubing, and it can, therefore, be easily transported to a repair point, at which illuminating gas or acetylene is not available. However, if it is a question of welding exceptionally heavy bodies, or of sheet metal 0.8 to 1.2 inches in thickness, it is absolutely necessary to utilize the acetylene-oxygen flame if the expense is to be kept from becoming too great. The cost per welding seam with sheet iron 0.12 inch in thickness is approximately 7.5 cents if acetylene gas is used, and is about 20 cents with metal of double the above thickness. In this connection it should be remarked that, as is always the case in soldering or welding operations, the skill of the workman is an important factor in increasing or lowering the cost of the work.

Autogenous soldering is capable of utilization in an exceptionally great field, and this is demonstrated by the fact that in France alone there are over twelve hundred factories in which the various metals are autogenously soldered or welded, in every possible branch of metallurgy. Examples of the possibilities offered by autogenous soldering are given in the following list, which is by no means complete:

1. The manufacture of boilers and reservoirs, and the making of repairs upon the same, with sheet metal up to 1 inch in thickness.
2. The replacing of riveting in thinner sheet metal.
3. The manufacture of tubes of all dimensions.
4. The welding on of struts, flanges, etc.
5. The repair of castings (gas bubbles, pipes, and casting faults).

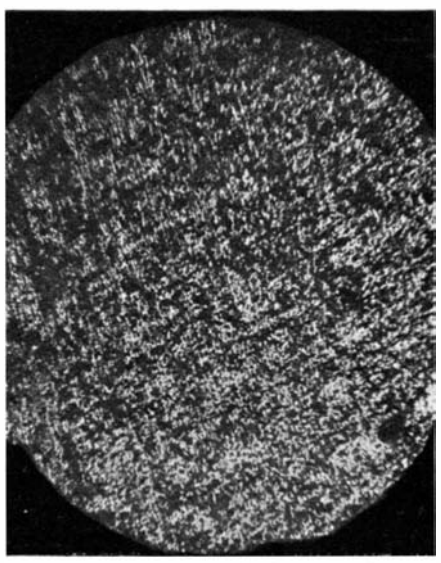
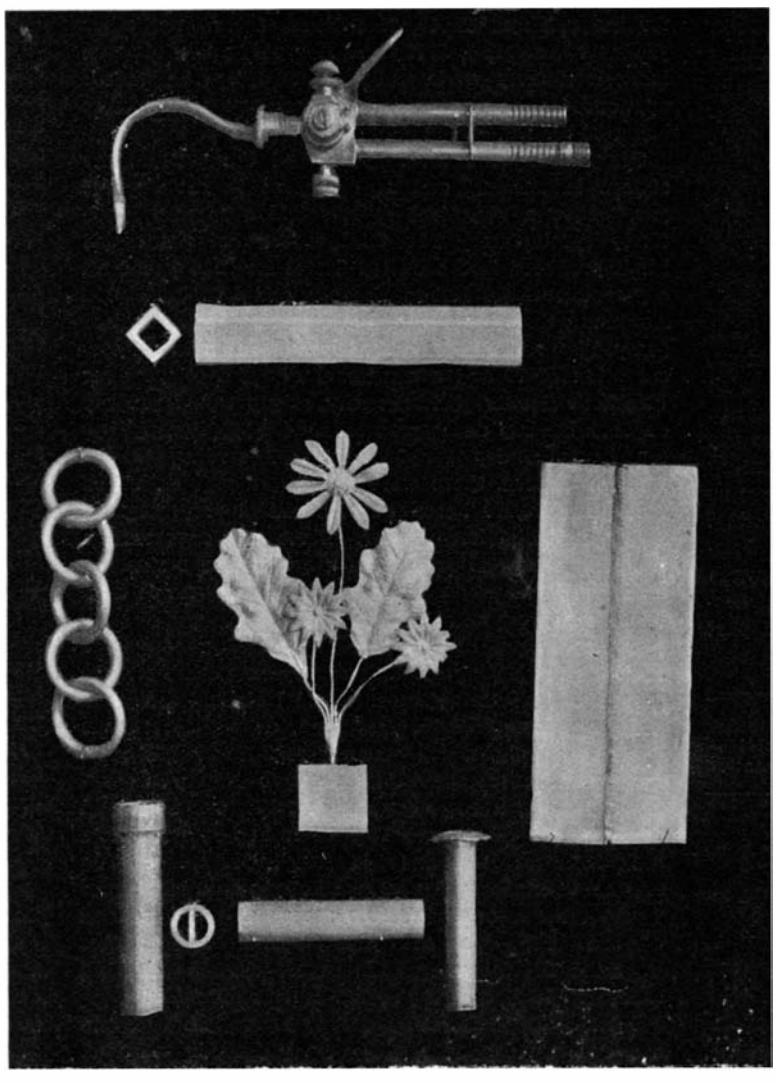


Fig. 2.—Cross-Section of Unsoldered Aluminium. Greatly Enlarged.

6. Repair of valves and autoclaves, the production of pipe conduits without connections for the chemical industries.
7. Artistic wrought metal work, industrial sheet metal and enamel ware, and safes.
8. The manufacture of military articles.
9. The manufacture of iron casks and superheaters.
10. The bicycle and automobile industries.
11. The working of rare metals, such as gold and platinum.

The two metals which formerly appeared to be absolutely precluded from autogenous soldering are nickel and aluminium. Nickel possesses the characteristic that when heated it absorbs oxygen from the air, and for this reason becomes brittle and useless. Aluminium, when it comes into contact with a hot flame, becomes covered with a film of oxide which, despite the fact that it is extremely thin, absolutely prevents the combination of the two softened aluminium parts. If it were possible to discover for nickel some borax-like substance which would effect the hermetic exclusion of the air during the soldering process, and for aluminium a substance with which the gathering aluminium oxide films would enter into solution, that is, would be reduced, it would be possible to effect the soldering of nickel as well as aluminium with the same ease with which other metals are similarly worked. The writer has succeeded in solving these two problems, and both soldering or welding processes have been in operation on a large industrial scale for some time past. The vast field offered by the soldering or welding of aluminium, the "metal of the future," is seriously belittled by no one competent to judge. And it is demonstrated by this fact alone, that the solution of the problem has occupied the attention of a considerable number of inventors and industrial experts from the time of the discovery of the metal, and that, lacking a proper soldering process, some forty hard soldering methods have been tried, proposed, or patented. All these numerous attempts to weld aluminium to aluminium with the aid of the bond provided by a "foreign metal" must be considered unsuccessful, as at the soldering points local electrolytic action, due to the formation to a certain extent of galvanic currents, arises. This manifests itself very rapidly and unpleasantly, particularly in the presence of water, and it attacks the soldered point with absolute certainty. As a matter of fact, it is a characteristic property of aluminium that its behavior with regard to other metals is unfavorable and, regardless of soldering or welding, it behaves better the purer it is. Recognizing the truth of this theory, the various aluminium factories have attempted, at all times, to supply the metal in as pure a condition as possible. According to different tests, it would appear



Aluminium Objects Soldered by the Schoop Process. At the Top Appears the Blowpipe Which is Used.

THE AUTOGENOUS SOLDERING OF METALS.

* See Electro-Chemical and Metallurgical Industry, July, 1905. "On Autogenous Lead Soldering," by M. U. Schoop.

that chemically pure aluminium is capable of resisting even sea water, a fact which is of great importance in marine engineering.

The credit for having first welded aluminium must be conceded to the Heraeus Company of Hanau, Germany, which, as early as 1900, exhibited at the International Exposition at Paris a number of aluminium articles, which had been welded by means of a special process (German patent 118,868). This process is based upon the fact that at a certain degree of heat aluminium becomes soft, and can be combined with a similarly-heated aluminium body by means of hammering. In principle this method corresponds exactly to the well-known welding process used for iron in the ordinary smithy. This method, however, has a disadvantage which tends to prevent its introduction into practice, which is that it is extremely difficult to maintain the exact temperature necessary for the welding, and it is possible only if the workman is extremely skillful. If the temperature is too high the metal, when hammered, will spurt in all directions, while if the heat is insufficient, no combination of the surfaces in question takes place. Accordingly, it is apparent that this process leaves much to be desired in practice, and is absolutely unsuited to the working of thin material or complicated objects.

In the autogenous blowpipe welding of aluminium according to the Schoop process, no question of this character can arise. Upon purely theoretical grounds it appears that the formation of local galvanic circuits is impossible if foreign metals are not present. Furthermore, the thickness of the metal is quite immaterial, and it is possible to weld sheet aluminium 1 inch or 0.008 inch in thickness with the same ease.

On the recommendation of the Neuhausen Aluminium Factory, of Switzerland, a series of tests were made, the purpose of which was to show whether or not the welding point underwent disadvantageous changes if immersed in water for a longer time. As was to be foreseen from the theoretical considerations underlying the process, the results were in every particular negative. That is, even after months in contact with water the soldered or welded points were found to be in exactly the same condition as the other parts of the material. In one particular case a soldered aluminium article remained for three months in salt water, without the appearance of the slightest chemical or physical change at the soldered points. Similarly favorable were the results of the official rupture and tension tests executed by the testing laboratory of the Conservatoire National des Arts et Métiers at Paris in May, 1905. Of greatest interest by far are the results of a photo-micrographic investigation carried out by the same institute. As is well known, a test of this character is extremely sensitive, and the slightest changes of a metal in regard to its structure, color, and constitution are at once perceptible with mathematical certainty. The result of this test showed that the welding points possessed exactly the same characteristics in regard to their chemical and physical properties as did the pure aluminium, and, furthermore, not even the slightest trace of impurities (resulting from the flux) could be determined.

The soldering or welding process itself is as follows: The parts to be joined are either bluntly placed against each other or one above the other, after all adhering dirt has been removed from the surfaces. However, aluminium which has a bright appearance needs no preliminary cleansing, in contrast to that usual in the hard-soldering process with copper, brass, etc. The Schoop reducing liquid is now applied with a brush, and the flame, which is regulated according to the thickness of the material, is then applied to the metal. Aside from the application of the reducing liquid, the process of operation is exactly the same as in the case of the well-known process of lead burning.

The following table gives the cost of sheet aluminium soldering in which the illuminating gas-oxygen flame is used for heating purposes, the mixture consisting of about 2 parts of illuminating gas and 1 part oxygen:

Thickness of the sheet metal in inches	Mixture of oxygen and gas.		Wages in cents.	Total in cents.
	Cubic feet.	Cost in cents		
0.02	0.35	0.57	0.57	1.14
0.04	0.42	0.67	0.75	1.42
0.08	1.27	2.07	1.50	3.57
0.12	2.65	4.37	2.00	6.37
0.20	4.59	7.50	3.75	11.25
0.32	12.37	20.00	6.25	26.25
0.40	15.90	28.00	7.50	35.50
0.48	26.14	42.50	10.00	52.50

Illuminating gas at $1.12½ per 1,000 cubic feet.
Oxygen at 1.35 cents per cubic foot.
Labor at $1.50 per 10 hours.

The Current Supplement.

The first of three installments of an article on the manufacture of illuminating gas is published in the current Supplement, No. 1626. The first installment deals with the making of coal gas. Mr. C. W. Parmelee writes on the technology and uses of peat. A very good monograph on corn-harvesting machinery is also published. Henry H. Quimby writes on concrete surfaces. Prof. F. B. Crocker and M. Arendt discuss the advantages and applications of the electric drive. The second installment of the article on the utilization of waste materials is published. The black sands investigations of the United States Geological Survey are described and illustrated. The English correspondent of the Scientific American writes on types of early steam engines still working in England. A few problems of the preserving industry are considered by Dr. E. Krüger.

THE MAGNITUDE OF THE GAS INDUSTRY.

Illuminating gas, which is piped into our buildings as freely as water, is the aeriform product of the destructive distillation of a liquid or solid hydrocarbon which may, or may not, be diluted by the admixture of other combustible gas or gases. Bituminous coal or petroleum, or some of the products of the fractional distillation of petroleum, form the basis of the manufacture of gas. Some idea of the size of the industry may be obtained when it is stated that in 1905 the total value of the raw materials used was $37,180,066. It is interesting to see how the materials are distributed. First we have the item of coal, 4,431,774 tons, costing $14,607,485; next we have 403,263,738 gallons of oil, which cost about the same, the sum being $14,531,585. Coke is a smaller item, 435,534 tons, costing $6,176,340. Vast quantities of water are required, no less than 5,430,361,158 gallons being used. Fortunately, water is not very expensive, $253,895 representing its total cost. Other materials amount to $6,176,340.

Our total cost was $37,180,066. Now, what is the value of the product? The hand of man—the chemist co-operating with nature by the use of the materials of her mineral kingdom—has succeeded in making a subtile aeriform mobile product, valued at $112,662,568 and occupying the enormous bulk of 112,486,783,148 cubic feet.

The product is divided both as to kind and value as follows:

	Cubic feet.	Value.
Straight coal gas.....	12,674,033,691	$12,868,604
Straight water gas.....	715,550,006	832,440
Carbureted water gas.....	54,687,118,030	48,071,180
Mixed coke and water gas..	40,980,413,950	45,605,263
Oil gas.....	3,397,456,873	5,141,460
Acetylene gas.....	7,880,666	104,267
All other gas.....	24,329,932	39,354

Not only do we have these valuable gases, but we have by-products as well. Coke, valued at $5,195,461, represents 89,146,434 bushels; while $2,064,343 stands for the value of 67,515,421 gallons of tar. All other products are worth $972,992. A considerable revenue is derived from rents and sales of lamps and other appliances, such as stoves, the amount of this business being $4,249,581.

Comparison of raw materials and the product are always interesting, and especially so in the case of gas, where a graphical representation becomes positively spectacular. The total amount of gas of all kinds produced in the United States for 1905 would fill a gasometer 5,829 feet in diameter and 4,556 feet high. Assuming that a gas engine consumes 92 cubic feet of gas per hour, being the mean between a minimum consumption of 70 and a maximum of 115 feet per hour (Mathot's figures) this quantity of gas would run gas engines having an aggregate of 407,560 horse-power ten hours a day for 300 days. According to the Twelfth Census, there were 14,884 gas engines, which furnished 143,850 horse-power, a pitiful percentage of 1.3 of the total horse-power. Since this enumeration the number of gas engines in use has been materially increased; but even so, the great bulk of gas is used for illuminating and heating purposes.

A comparison of the yearly production of gas is unwieldy, owing to the lack of objects with which to compare. The Eiffel Tower would look lost compared with a gasometer 4,556 feet high, so we have taken a week's supply, which amounts to 2,163,207,368 cubic feet. This enormous bulk is shown in our engraving stored in a huge gasometer 1,620 feet high and 1,350 feet in diameter. The water is contained in a tank 241 feet high and 268 feet in diameter. The raw materials are also of a bulky nature. The coal would form a cone 268 feet across at the base and 200 feet high. The coke also forms a cone 120 feet high and 160 feet across the base. The oil would fill a barrel 155 feet high and 122 feet in diameter.

For the benefit of our readers, we are publishing in the Supplement an elaborately illustrated technical article on the production of both coal and water gas. There is nothing which is more conducive to comfort than this colorless aeriform fluid, which is brought to our doors and consumed for light and heat, our comforts.

Correspondence.

Eyeglasses as Telescopes.

To the Editor of the Scientific American:

In the Scientific American of December 29, 1906, page 484, appears an article on the use of a single lens as a field glass. I have made use of this principle for a long time, and it may not occur to many of your readers that they themselves have the necessary lens, with the proper correction for their eyes, ready for use at any time. I wear a compound lens, +.50 +.25 —90 deg. By holding this at arm's length, objects appear about one-third larger. Being able to use both eyes, and having each eye see through the *center* of its own lens, is a great improvement over using a single lens.

The easiest way to get objects in focus is to take the glasses from the nose, and while looking at the object through the glasses, extend the arm to full length, taking two or three seconds' time for the movement. In this way the object is easily centered, and the eyes are not strained.

I have made out the names of boats in a race, that without the glasses extended showed only by the difference in the color of the paint. Once when my arm was not long enough to get the desired magnification, the glasses were hung on a twig, and by getting about five feet back, the result was satisfactory.

Near-sighted people, and perhaps those wearing very strong plus glasses, cannot make use of this method, but there are many others who can.

John V. Frederick.

Lancaster, Pa., January 2, 1907.

"The Battleship of the Future."

To the Editor of the Scientific American:

I was much interested in the article on the "Battleship of the Future" accompanied by sketch designs. The particular arrangement of turrets arrived at by the author, however, seems to me to be open to grave objections. The concentration of the weight of four turrets and the large barbette on a small area, itself not coincident with the area of maximum buoyancy, would produce enormous shearing forces, which in turn by their integration would give rise to great bending movements.

To resist these severe stresses it would be necessary to give the hull considerable local reinforcement near the turrets, and to provide the structure as a whole with excessively heavy longitudinal members.

The weight involved in these arrangements would probably balance the weight in armor saved by the peculiar location of the turrets.

The very arrangement of the barbette makes it difficult to secure proper continuity of the longitudinal strength, as it apparently cuts all the upper strength members except the sheer strake. Even supposing it were possible to build such a vessel, the design would not be practicable for the reason that the author has left the sheer strake entirely unprotected by armor. Now suppose she engages in battle in a moderate sea; a few high-explosive shells amidship would cut up her sheer strake, deck stringers, etc., and it is quite possible that she would break in two under the action of the waves. In the Japan Sea battle the shells tore huge gaps in all structural plating wherever exposed, and I think this design would be extremely vulnerable under these conditions.

Another important consideration is the location of the handling rooms, which are of course vertically under the turrets. The author does not take up this question, but it would be necessary to have either a single large room, or several smaller ones close together; and further, the handling rooms would extend well outboard on either side. Now a single torpedo explosion near this point, a single accident in the handling room, or a single 12-inch shell, would put all the turrets out of action—if, indeed, the adjacent magazines were not detonated, and the whole ship destroyed.

I believe that the battleship of the future will carry twelve 12-inch guns in six turrets on the center line.

The center line of the ship is the proper location for a turret, since there the guns command the maximum arc of fire, the magazines and handling rooms are kept inboard—a very important point in these days of the perfected torpedo—and the deck stringers and other important members are not cut. George B. Moody.

Bath Iron Works, Bath, Me., February 15, 1907.

To the Editor of the Scientific American:

After reading Mr. Cardullo's discussion of "The Battleship of the Future" I beg to say that while his facts and arguments are intensely interesting, and really valuable, he seems to fail to comprehend fully the work for which battleships are designed primarily—or ought to be designed.

Battleships are not built to resist attack. They are built to attack and destroy the enemy. Speaking of speed, Mr. Cardullo says "the faster ship may theoretically choose her position and range, but if she is

overmatched in guns and armor at all ranges her only choice is to run." That is true, but what he ought to have said—what it is infinitely more important to observe—is that if she is overmatched in speed her only choice is to let the enemy run away, no matter what guns or armor she may carry. And if she is overmatched in speed and guns her only choice is to surrender (or sink), no matter what armor she may carry. For, as Mr. Cardullo shows clearly, the thickest possible armor can be penetrated by the 12-inch gun at any fighting range.

Every American designer of battleships ought to hang up two mottoes in his workshop: "Remember the 'Essex'!" "Remember Farragut!" For the "Essex" was captured at Valparaiso because she did not have enough motive power to enable her to get within range of the "Phoebe." If we are to remove the eagle from our shield and put the porcupine or the terrapin in its place—if we are to wait for the enemy to come to our harbors to do the fighting, and when there to choose his time of fighting and his range—then speed is of less importance than armor. But the men in our navy who can be trusted to defend our country by forcing the fighting, are a unit in demanding ships that will have, first of all, power to reach the fighting line in spite of the enemy's modesty; and when there will have guns to demonstrate the truth of the immortal words of Farragut: "The best protection against the enemy's fire is a well-directed fire from our own guns." JOHN R. SPEARS.

Northwood, N. Y., February 16, 1907.

The Scientific American in Syria.

To the Editor of the SCIENTIFIC AMERICAN:

It is becoming better known among scholars, that to the Arabs and to the Arabic language modern learning and modern civilization owe a great debt, not only because of the direct contributions of the Arabs to the sciences of mathematics, chemistry, astronomy, and metallurgy, but also because they saved for us and transmitted to us so much of the learning of the ancient Greek civilization. There was a time when the "glimmering light of knowledge was all but ready to die out," and would have done so but for the Arabs. Many of the noblest scientific works of antiquity had disappeared from the languages in which they had been written, and were saved to us through the Arabic. It was thus that the works of Plato and Aristotle and Euclid traveled by way of Bagdad, Bassora, Sicily, Cordova, and Seville into Europe.

Now I am sure that your readers will be interested to learn that you in your publications have for years been making a return in the nature of a partial payment of the debt we owe the Arabs, which has come about in this way: For more than forty years the American Presbyterian Mission in Syria has published a newspaper in the Arabic language called the Weekly Neshera, which circulates well over the Arabic-speaking world. It has always been an aim to give to its readers the latest and most accurate accounts of all discoveries in science, together with a record of the yearly advance of learning. We have found nothing to equal the SCIENTIFIC AMERICAN for this purpose, so that as a result it is well within the facts to say that during the forty years there have been translated from its pages into the Arabic as many as two thousand articles and paragraphs. In recent years the Arabic newspapers in Beirut alone have increased to as many as twenty, and these in turn copy most of the scientific articles, and give them a still wider circulation among Arabic readers. FRANKLIN E. HOSKINS.

Beirut, Syria, January, 1907.

Sweet Milk and Indigestion.

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue of the SCIENTIFIC AMERICAN I find an article concerning sweet milk, and I also find municipalities making war on dairymen, directly and indirectly accusing them of selling unclean milk.

In this connection, being myself a specialist in the treatment of indigestion, I would like to make known to the people and scientists through the SCIENTIFIC AMERICAN just what I have discovered in regard to sweet milk.

I find that thousands of people who are well and hearty seldom, if ever, drink sweet milk, whereas the majority of those who are sick, ailing, or chronic invalids drink it, many to an excess, and as a rule those who are the most ill drink the most milk. I also find in treating stomach trouble of years' standing that they cannot be cured unless sweet milk is withheld from the diet, but that they can be permanently relieved in a very few days if it is withheld. I do not wish to be understood, however, that abstaining from milk will cure chronic indigestion, but when sweet milk is used, the cure is apparently impossible.

One instance: A patient was sick for years with what is known as dyspepsia and prolapsus in its worst form. Former physicians gave her largely a diet of sweet milk, but she received no benefit for either complaint. On beginning my treatment, I had her abstain entirely from sweet milk, not even taking cream in coffee, and in a fortnight she had recovered from nearly all ill effects of indigestion, and possessed the ability to digest three hearty meals per day, and was soon entirely well of both complaints.

Just why sweet milk has this effect in stomach trouble I cannot say, but would like to find out.

Yet I know a great many physicians prescribe a sweet-milk diet in treating dyspepsia and other chronic ailments. CLAY HARPOLD.

Cleburne, Texas, January 18, 1907.

The West Indian Hurricane.

To the Editor of the SCIENTIFIC AMERICAN:

I note with interest Mr. Wilmoth's article in your issue of December 22, stating that the injury to timber, crops, and shipping in the West Indian hurricane of September 26 and 27 was due, not to the storm so interestingly described in your issue of November 24, but to another storm which blew in an opposite direction, i. e., northwest, as shown by the thousands of trees broken, all of which point to the southeast.

Mr. Wilmoth assumes that there were two storms, one from southeast to northwest (as stated in your article), the other from northwest to southeast, the edges of the two storms meeting or overlapping near the eastern boundary of Mississippi.

This phenomenon, which Mr. Wilmoth believes to be very rare, results from the well-known whirling of winds about a cyclonic center, the motion of the wind in a hurricane being closely analogous to the movement of water discharging itself by a vent at the bottom of a basin. If the water be given a slightly rotary motion before the vent is opened, the threads of liquid, instead of moving radially inward, will be deflected so as to form a rapidly whirling eddy or vortex of increasing velocity toward the center. The centrifugal force developed by the rapid whirling of the water on a small radius produces a distinct depression on the water surface at the center, and may become so great as to open an empty core.

In the foregoing, the top of the water represents the bottom of the atmosphere; the downward discharge of water corresponding to the convectional ascent of the air, and the whirling escape of the water representing the whirling inflow of winds, moving gently at first, but increasing in velocity as the center is approached until a hurricane violence is attained, close to the central area of dead calm.

Because of deflection, due to the earth's rotation, these cyclonic winds move spirally inward toward the area of least pressure—in this hemisphere, in a direction counter to the motion of the hands of a watch; from which it is evident that the direction of the wind, at any point in a cyclonic system, depends entirely on the position of the observer with reference to the center of the storm.

If his position lies on the center of the storm track, he will note first a gentle southeasterly wind, gradually increasing in velocity and shifting somewhat to the south; the thermometer falling, temperature rising, and cloudiness turning to rain or snow. On the approach of the central area of least pressure, the velocity of the wind becomes excessive, and the centrifugal force increases at a rapid rate; then follows a period of comparative calm, the air being held away from the storm center by the excessive centrifugal force. Shortly after, the wind veers more or less suddenly to the northwest, increasing to hurricane violence as the barometer rises and the temperature falls. This sudden reversal of the winds is due entirely to the storm's progression, which brings the observer successively under different parts of the spiral whirl.

If Mr. Wilmoth will keep the above in mind, he will have no difficulty in identifying his two overlapping storms as integral parts of the hurricane of September 26 and 27, described in your issue of November 24.

Chicago, Ill. DAVID J. BLOCK.

THE MOTOR BOAT SHOW AT MADISON SQUARE GARDEN.

BY A. E. POTTER.

The First Annual Motor Boat Show, divorced as it was from the Sportsman's Show, which has come to be one of the fixtures of the late winter, closed last Tuesday night after a remarkably successful run of seven days and nights at Madison Square Garden, New York city. The Fourteenth Annual Sportsman's Show opened last Friday and will last until Saturday.

On entering the Garden, one was at once struck by the changed conditions. Rustic bridges and hand rails and decorations of firs were not in evidence, nor was there the tank that had been seen for two seasons previously. There was present, however, an air of business that assured success from the outset. Very little had been spent for decorations, fancy signs, etc., but there were numerous boats, engines, and accessories exhibited. Although many of the exhibits were meritorious, the Show was hardly representative of the industry, as many prominent and favorably known builders were absent.

The West was largely represented by both hulls and engines. New York and nearby motor-boat and engine builders were fairly numerous, while New England furnished but four or five exhibitors of either engines or boats.

The high development of the boat builder's art was reflected in a number of fine creations contributed by several well-known firms. These beautiful craft, finished in the natural wood and polished like mirrors, were carefully and critically examined and inspected.

The Michigan Boat Company and Detroit Engine Works, of Detroit, Mich., exhibited a line of boats at such low prices as to bewilder one who was familiar with the cost of construction of such craft, when laboriously contrived without the aid of up-to-date woodworking machinery and modern manufacturing methods. Their exhibit of knockdown frames was the only one of the kind in the Show, as was their power canoe. They also had on exhibition a knockdown frame assembled ready for planking. Their steel boats were also interesting and showed considerable development in this type of hull.

The Mullins Boat Company, of Salem, Ohio, had an unusually large line of their famous pressed-steel boats on exhibition. The one which attracted the most attention was a 35-foot by 7-foot day launch with torpedo stern, protected propeller, three-armed shaft strut, and balanced rudder. The six-cylinder engine was placed under a hood at the bow with the entire control attachments on the bulkhead, which divided the engine compartment from the commodious and well-arranged quarters amidship and aft. The steel used in this boat was No. 12 gage, smooth seamed, galvanized, and carefully riveted and soldered. The skin of the boat was not attached to her strong, bent, oak frames. The method of fastening the sides was novel and betokened great strength. The keel was of oak, to the bottom of which was bolted a heavy T iron. The sides were extended and riveted through the lower extension.

Mention should be made of the Atlantic Company's exhibit. These boats were built at Amesbury, Mass., and were remarkable for their apparent seaworthiness. Two were dories, while the third was a 23-foot open boat with canoe stern and dory bow. The dory may not strike the fancy of power boatmen all over the world, but in New England, where its value is appreciated from its utility and safety, its appearance meets with popular approval, and the use of the power dory is extending surely and rapidly.

The Williams-Whittelsey Company, of Steinway, L. I., showed an interesting collection of complete models, built to scale. This is the first time that models have been put on exhibition by motor-boat constructors. Two of the boats shown in this way were new ones now under construction, while the other two were boats already in existence, one of them being the U. S. coast defense inspection boat "Norka," which was illustrated in our Motor Boat number.

Among the interesting engines of the two-cycle type were noted several that showed considerable ingenuity in their design and construction. One of these, for example, was a 4-cylinder double-acting, vertical engine having explosion chambers at each end of the cylinders and compression chambers between. This motor was an extremely smooth-running and light affair. Still another interesting two-cycle motor was one in which a positively-actuated inlet valve was used for the introduction of the charge into the cylinder.

The exhibitor occupying the most space was the Truscott Boat Company, which had the entire eastern end of the Garden. This company showed its usual superior line of boats, and a decided novelty in engine construction. This was of the four-cycle type, with cam shaft mounted on top of the cylinders, driven by sprockets and a noiseless chain passing up inside the casting between the cylinders, which were cast in pairs. The cylinders had dome heads cast integral. The valves were of the removable cage type, and were operated by rocker arms. Some of the claims of this construction were extreme accessibility and conservation of power by reducing the loss from radiation to the minimum.

Another extremely interesting engine was the five-cylinder, air-starting Dock engine of 30 horse-power, now being built by the New York Safety Steam Power Company, of this city. In the accompanying illustration, which shows the inlet side of the engine, may be noted the air compressor and controller on the front. A reducing valve in the air-supply pipe is interposed between the air-storage tank and the fitting *I*, between the carbureter, *C*, and check valve, *V*. To start the engine air enters the fitting, *I*, passes through the carbureter, *C*, the check valve, *V*, preventing its escape, and enters the cylinders only when gas is taken into them in the usual cycle, that is, at each alternate down stroke of the piston. This is accomplished by means of a novel arrangement of the inlet valve here shown. There is a cylindrical bushing held in place normally by the inlet valve spring. This bushing has a sectional area greater than that of the valve head. When the air under pressure passes through the carbureter, it takes up its quota of gasoline vapor and enters the cylinders in the form of the usual explosive mixture. As it enters the valve chest the pressure bears on the balanced piston or bushing, forcing it

down the valve stem until it engages the retaining nut. This securely seats the valve, and prevents the entry of any gas until needed. When the cams on the lay or two-to-one shaft open the inlet valve, the balanced piston and valve move together.

This engine has been used two seasons and has done excellent service. It has been found extremely economical in air used for starting. The engine is a marvel of simplicity as to its air-starting arrangements.

The Art Machine Company, of Brooklyn, N. Y., had two exhibits. On the main floor were seen sectional and full models of the Fulton engine, celebrated two years ago by being selected as the motive power in the widely known Knickerbocker Yacht Club one-design power-boat class, or "Sea Skunks." One of these craft was shown complete in every detail, reduced to one-quarter size.

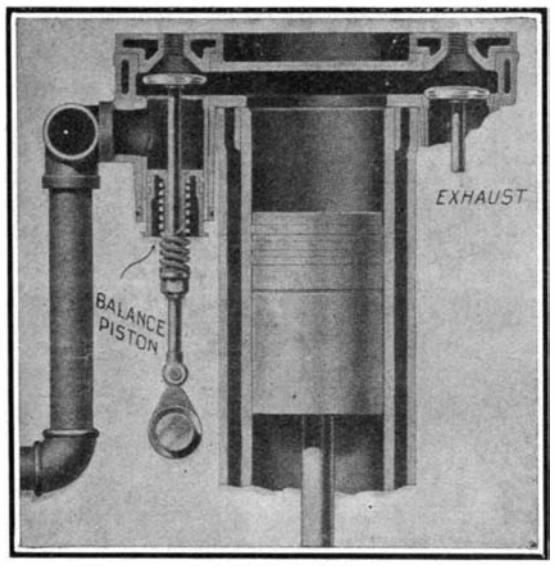
In the gallery was shown an economical electric soldering iron, connected with an ammeter and voltmeter. It showed a consumption quite remarkable. An iron equivalent to a 4-pound regular copper took 2⅛ amperes of a 116-volt current, while a larger size, equivalent to a 6-pound copper, took but ⅛ ampere more.

Showing that heavy-duty engines are in demand, the Buffalo Gasolene Motor Company, which has heretofore built only high-speed engines, has placed on the market a line of their slow-speed heavy-duty machines, one of which was exhibited.

Altogether, there were three high-powered engines exhibited. One was the 300-horse-power, double-acting "Standard," which, together with the boat that it drove last autumn a mile in record time, was illustrated in the Motor Boat number.

Another was a 250-horse-power engine, built by James Craig, Jr., of this city. This is the type of engine used in Holland submarines, such use necessitating a light, strong engine. The third was the 150-horse-power "Speedway," manufactured by the Gas Engine and Power Co. and Chas. L. Seabury & Co., Consolidated.

One of our illustrations shows this engine. It is of the usual four-cycle type and is made up of six cylinders, having an 8½-inch bore by 10-inch stroke. Its power rating is at 550 R. P. M., and it is capable of being speeded up somewhat, and developing still more power for high-speed work. The valve arrangement is similar to that used heretofore. In addition to the high-tension ignition system (the current for which is supplied from a storage battery and a small dynamo that charges the same), low-tension magneto ignition is also fitted. The make-and-break igniters are seen in the valve chambers of the six cylinders. They are operated by rods extending downward to a special igniter cam shaft, which is placed beside the usual half-speed cam shaft and driven from it by gears. The mechanism is such as to give a very quick break at the igniters. A Sims-Bosch low-tension magneto is driven from the ignition cam shaft, and hence its armature is always kept in the proper relation with the breaking point of the igniters. The engine is provided with a governor, which closes the throttle and keeps the engine from racing when the clutch is thrown out. The cylinders and wrist pins are lubricated by a force-feed oiler, and the main bearings and crank pins by a gravity-feed oiler. The crank pins are furnished with centrifugal oil rings. The cylinders are mounted upon cast box-shaped sections, each of which is bolted to the bed plate of the engine. The engine is cooled by water circulated through the cylinder jackets by means of a gear-driven gear pump. The water first passes through the cylinder jackets, entering on the exhaust side; it then passes through outside connections leading from the upper part of the cylinder jacket to the cylinder heads (which are removable), and finally passes around the water-jacketed exhaust pipe. The engine is started by means of compressed air, which is let into three of the cylinders. The air is obtained under pressure by means of a small compressor driven by the engine. It is stored in a small reservoir under a pressure of 60 pounds to the square inch. The carbureter is located above the engine in an accessible position. It is of the overflow type, being supplied by a small plunger pump worked by the engine. The inlet pipe and the carbureter are heated by the exhaust gases of the engine, which pass through suitable jackets around them.



Cylinder of Dock Engine, Showing Inlet Valve Carried in a Balanced Piston.

The Holmes 25-horse-power four-cylinder four-cycle auto marine engine, built by the Holmes Motor Company, of West Mystic, Conn., attracted considerable favorable comment. This is the engine that stood the severe test at the hands of the U. S. life saving service officials recently, on Lake Michigan. It is an especially get-at-able engine, and has made a record for facility and speed in assembling and disassembling.

The attendance during the show was good. There was not present the morbidly curious crowd which has been in evidence in previous years, and the attention of would-be purchasers has not been continually diverted by aquatic and other scheduled events.

Another year it is hoped that uniformity of decorations and signs will be followed and that the spaces will be more evenly divided, which will be necessitated, provided many, who should exhibit, decide to take part in next year's Show.

WRECK OF AN ELECTRIC TRAIN ON THE NEW YORK CENTRAL.

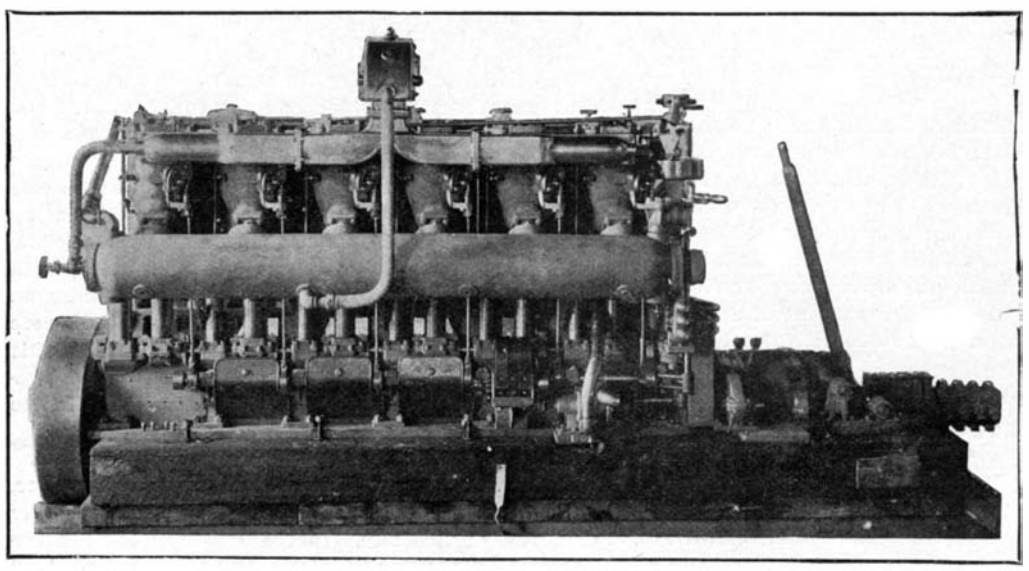
In addition to the sympathy which we feel for those who suffered in the recent derailment wreck on the New York Central Railroad, when twenty-three persons lost their lives and a large number received more or less injury, every one who is not blinded by prejudice must also feel sympathy for the railroad company that the inauguration of their costly and most excellent system of electric operation should have been darkened by this terrible tragedy. It is not for us to prejudge the case, but it certainly does seem that the worst that can be said against the management is that they failed to realize that even their splendid roadbed, whose reputation is known the world over, required some further adjustment to meet the heavier stresses incidental to the operation of electric locomotives. If our foresight were always as clear as our hindsight, accidents of this character would never happen. We believe that, as a body, engineers of the high professional training of those employed by our leading railroads are marked by great zeal and thorough conscientiousness in their work. But the history of engineering shows that when new problems are presented, it is seldom that the analysis of conditions grasps every new element and makes adequate provision therefor.

To take the case in point, the curve on which the accident occurred was an easy one, being of only three degrees variation from a tangent in every 100 feet of length. It called for a 4½-inch elevation of the outside rail, and under these conditions the centrifugal force would be about balanced on a train running at the speed of 46 miles an hour. At speeds above this the train would crowd against the outside rail with a pressure which would increase as the square of the velocity, and in the judgment of the engineers this speed could be run up to as high as 65 miles an hour without endangering the train. This, they claim, is the general railroad practice throughout the country. Now the reason that steam railroad tracks are not elevated for the highest speed is that slow trains are sometimes run over express tracks, and it is considered that the best compromise is to elevate the outside rails for the mean speed.

The elevation of the outer rail above the inside rail is done in obedience to Newton's first law of motion, according to which a body will continue in its state of uniform motion in a straight line unless compelled to alter that state by force impressed upon it. Thus, when a train enters a curve, its tendency under this law is to continue to run in a straight line, and the "force impressed upon it" is represented by the reaction of the outside rail of the curve, which thrusts the train laterally from the straight line, with a pressure which increases directly in proportion to the weight of the train, in the inverse proportion to the radius of the curve, and directly as the square of the velocity with which the train is moving. This product of the weight, speed, and curvature is known as the centrifugal force; and when a train is running on a curve which has no elevation of the outer rail, a point is soon reached at which the resultant of the weight of the train acting vertically and the centrifugal force acting horizontally, will pass outside of the outer rail and result in the overturning of the train, or the climbing of the wheels over the track, a condition which is represented in one of the accompanying engravings. In order to counteract the lateral centrifugal effect, the outer rail is elevated and the car tilted toward the inside of the curve. If this elevation is of just the right amount for the sharpness of the curve and the speed of the train, the resultant of the weight and the centrifugal force will lie in a direction normal to the track, and the train will have no disposition to bear against either the outer rail or the inner rail. If the elevation is too small for the speed and curvature, the train will bear against the outer rail, and if the elevation is too great, the train will tend to bear against the inner rail.

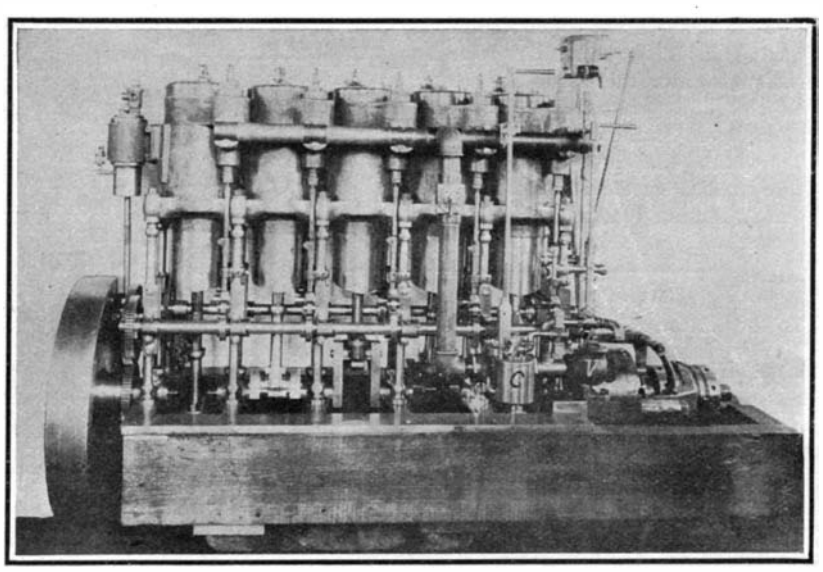
Now, since the accidents due to jumping the track or the spreading of the rails always occur on the outer rails, it is evident that it would be better to have an excess of elevation rather than otherwise, thus relieving the outer rail, even when the fastest expresses are running around the curve, and permitting the slower trains to run against the inner rail, against which there is but slight risk of derailment. It is true that because of the action of the coning of the wheels, the resistance of the slower trains may be somewhat increased by this arrangement; but the increase would not be sufficient to counteract the enormous advantage derived from having an absolutely safe-riding track.

In the case of the accident on the New York Central, an inspection of the curve on the morning after the accident, when the track had been once more put in shape, showed that the spikes on the outside of the



Exhaust Side of the 6-Cylinder, 150-Horse-Power Speedway Marine Engine.

Cylinder bore and stroke, 8½ x 10. Normal speed, 550 R. P. M. The special features of this engine are the separate igniter camshaft and the water jacketed exhaust.



Inlet Side of the 5-Cylinder Dock Marine Engine.

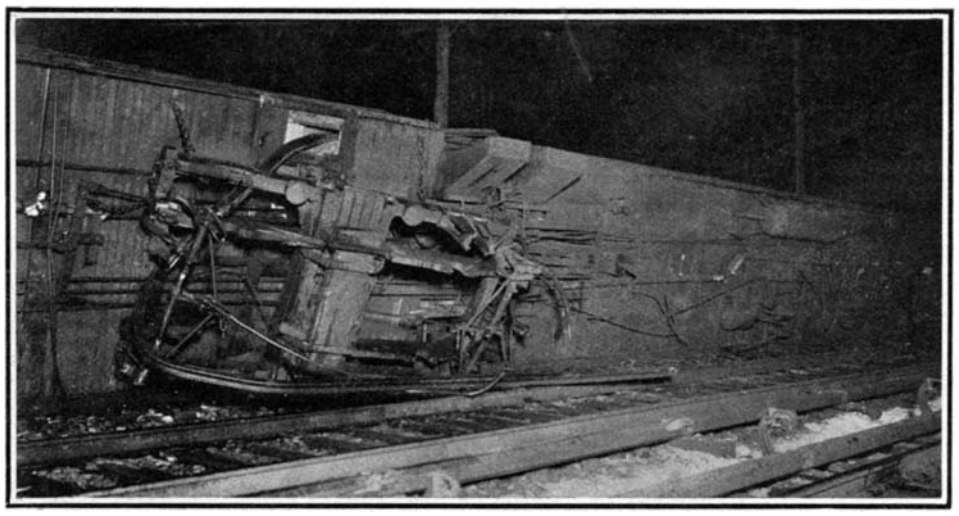
Cylinder bore and stroke, 5 x 8. Normal speed, 450 R. P. M. This engine has a special air starting device of great simplicity.

NOVEL MARINE GASOLINE ENGINES ON EXHIBITION AT THE MOTOR BOAT SHOW.

outer rail at the point of derailment had been neatly sheared off between the outer edge of the base of the rail and the tie-plates. Opposite the commencement of this rail, the ties on the inside of the curve were scored, while those on the outside were intact; which is clear proof that the outer wheels remained on the displaced rail, and jumped the track at the end of it, where the scoring of the ties on that side begins to be visible.

The train was made up of two 95-ton electric locomotives, followed by a combination baggage and smoker car and four ordinary day coaches. The weight of the two motors was about 190 tons and of the five cars about 200 tons. The condition of the track after the accident, the scoring on the ties made by the derailed wheels, and the fact that the two locomotives did not leave the rails, would indicate that the outer rail was driven out of place by the locomotives as they swept along the curve, and that as the cars reached the same rail they left the track, and tore through the adjoining third rail (which was stripped from its place and in some places wrapped around the trucks and even driven up through the cars, as shown in one of the accompanying illustrations), the cars finally overturning and sliding along upon their sides until their momentum was expended. It was during this last period that the fatalities occurred; for the passengers, being thrown against and through the broken windows on the lower side, were ground between the cars and the tracks as between the upper and the nether millstone.

The fact that for many years steam locomotives, heavier than these electric locomotives, have been hauling heavier trains than this one around these curves at speeds which were frequently between 60 and 70 miles an hour, without the occurrence of any accident of this kind, naturally points to the conclusion that there must have been something in the conditions on this train which produced heavier lateral stresses upon the outside rail than occur on steam-operated trains. If this be so, these conditions must lie in the locomotives, for the train was a light one. Why should these electric locomotives exert a heavier, or, rather, a more destructive, thrust against the rail than do the steam locomotives? The answer will be found in the accompanying diagram showing the two locomotives, from which it will be observed that 69 tons of the weight, being on the drivers, is concentrated within a space of 12 feet, and that the whole 95 tons

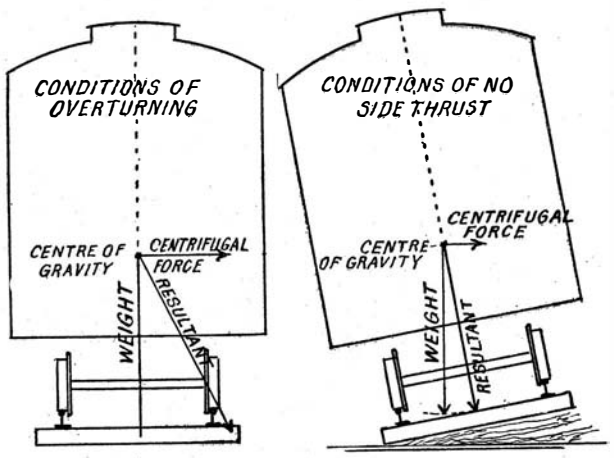


Bottom View of One of the Overturned Cars, Showing a Length of Third Rail Wrapped Around the Truck and Driven up Through the Bottom of the Car. Another View of This Rail Shown in Cut Below.

weight of each locomotive is concentrated upon a single rail length and the whole 190 tons weight of the two locomotives upon two rails' length. Although this is not a heavier average per foot, and, indeed, not so heavy, as that of some of the steam locomotives, it is much heavier, considered in its centrifugal effect against the outer rail; for the leading and trailing pairs of wheels are arranged to swing radially and give to the curvature. Hence, the main lateral thrust of these engines must be concentrated at the rigid wheel base represented by the four closely-assembled driving wheels. This effect is aggravated by the fact that the center of gravity of the four heavy motors, which are arranged concentrically around the axles, must lie at the center of these axles, or only 21 inches above the track. Consequently, the impact or surging of the locomotives against the outer rail must act with a much greater hammering effect than does the weight of a steam locomotive, which acts through a center of gravity which is much higher above the rails.

An inspection of the new rail, after the tracks were cleared up, suggested that there was a slight flattening of the curve at this point; that is to say, that the line of this rail lay somewhat inside of the true curvature. If this were so, it must follow that when the rigid group of four drivers on the first motor struck the rail, its natural effort would be to iron out the flat spot, as it were, and that it was in the effort to do this that the spikes on the outside were sheared off in succession as the motors swept by, and the whole rail pushed over into the position shown in one of our illustrations.

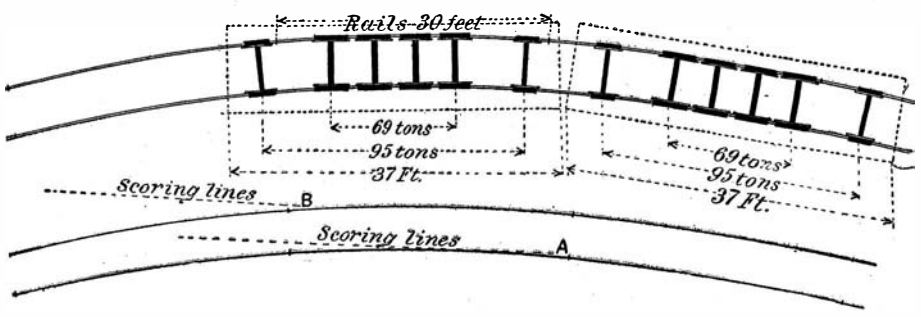
Now that electric locomotives are being introduced on steam railroads, we believe that special attention must be given to the question of maintaining curves at their proper alinement and elevation. Every maintenance-of-way engineer knows that the traffic tends to throw the curve out in both of these respects. For such service, it would be a good policy to elevate on curves for the maximum speed. Moreover, for the guidance of trackmen, it would be an excellent and not very expensive provision to place stone or iron bench marks and centers at every 100 feet around such curves; for these, being permanent, would give the trackmen a constant and reliable reference mark, and would obviate the necessity for their dependence upon the occasional visit of the engineer with his transit and level.



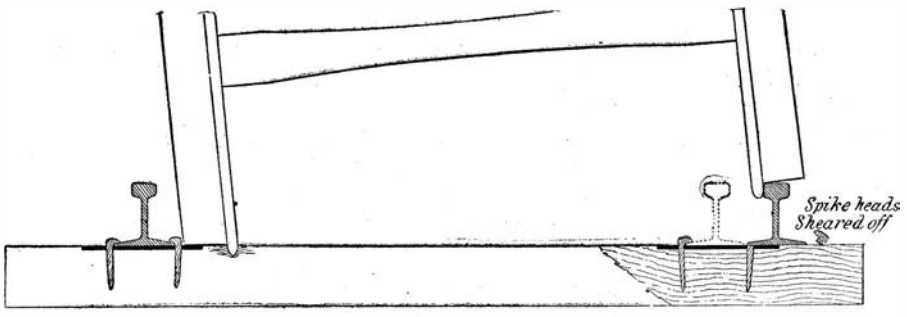
Approximate Diagrams, Showing the Effect of No Elevation and Full Elevation Upon the Stability of Trains on Curves.

The Resin Content of Jalap.

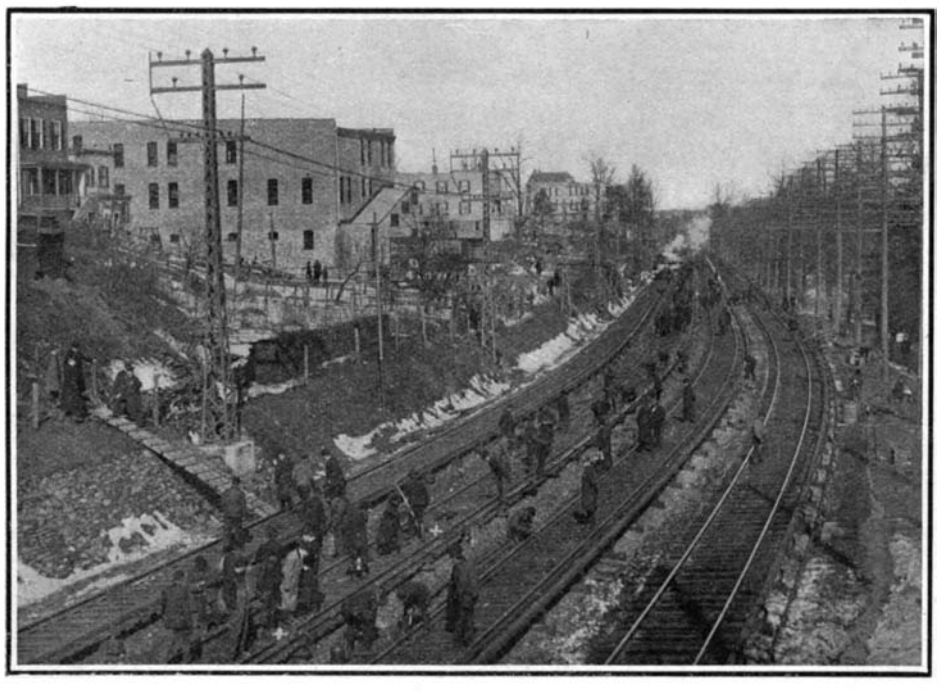
R. W. Moore (Journ. Soc. Chem. Ind.) has determined the resin content of 276 samples of jalap. The figures ranged from 15.63 per cent down to 2.10, the average for the lot being 5.95. Only twenty-six sample contained as much as 9.0 per cent of resin. The author remarks that the jalap imported into the United States is of extremely variable character, and much difference exists in packages from the same lot.



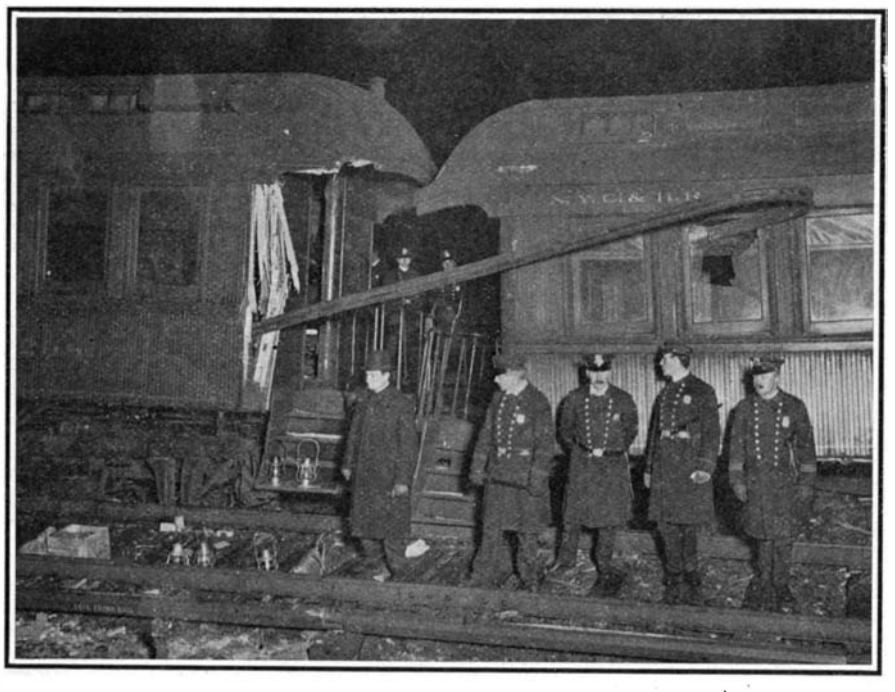
Upper Diagram Shows Relation of Weights and Length of Locomotives to Length of Rails Lower Diagram Shows Scoring of Ties at Point Where Outer Rail Was Spread.



Sectional View Showing How the Side Thrust Caused Outer Rail to Shear Off Spike Heads Between Edge of Rail Base and Edge of Hole in Tie Plate.



Curve on Which Accident Occurred. Spread Rail Shown by Two Crosses.



View After Cars Were Righted. The Third Rail Driven up Through Bottom and Side Post of First Car and Into Window of Second Car.

WRECK OF AN ELECTRIC TRAIN ON THE NEW YORK CENTRAL RAILROAD.

ELECTRICALLY-DRIVEN TARGET TRAINS IN THE GERMAN ARMY.

BY DR. ALFRED GRADENWITZ.

The officers of the German army have long realized that moving targets are quite indispensable for the training of artillery. Hitherto targets have been used which were pulled either by horses, by horse-driven capstans, or by stationary steam engines. As all of these three methods are inconvenient, another outfit for the moving of targets was sought.

Fowler steam traction engines were eventually adopted to transport the machinery required for moving the targets, and likewise to supply the necessary energy.

The plant includes two steam road locomotives, two battery vans, two capstan vans, and one water van or portable water tank for carrying feed water.

In addition to transporting the remaining vehicles to the proving ground, the engines serve for the charging of the accumulator batteries installed in the battery van, for which purpose a dynamo, driven through belt transmission from the flywheel, has been installed on a platform in front of the steam boiler. The steam boiler of the traction engine is designed for a working pressure of 180 pounds, and is equipped with compound steam cylinders, insuring a practically noiseless exhaust and high economy with respect to the water and coal consumption. The engine has toothed gearing for two traveling speeds in addition to a differential gearing for traveling on sharp curves. On the axle of the rear running wheel has been installed a rope winch with 445 feet of wire rope, which winch is directly operated by the engine, and serves for hauling the battery, capstan vans, and other heavy loads. This device excludes any possibility of involuntary stoppage to the cars, which are about 13,200 pounds in weight.

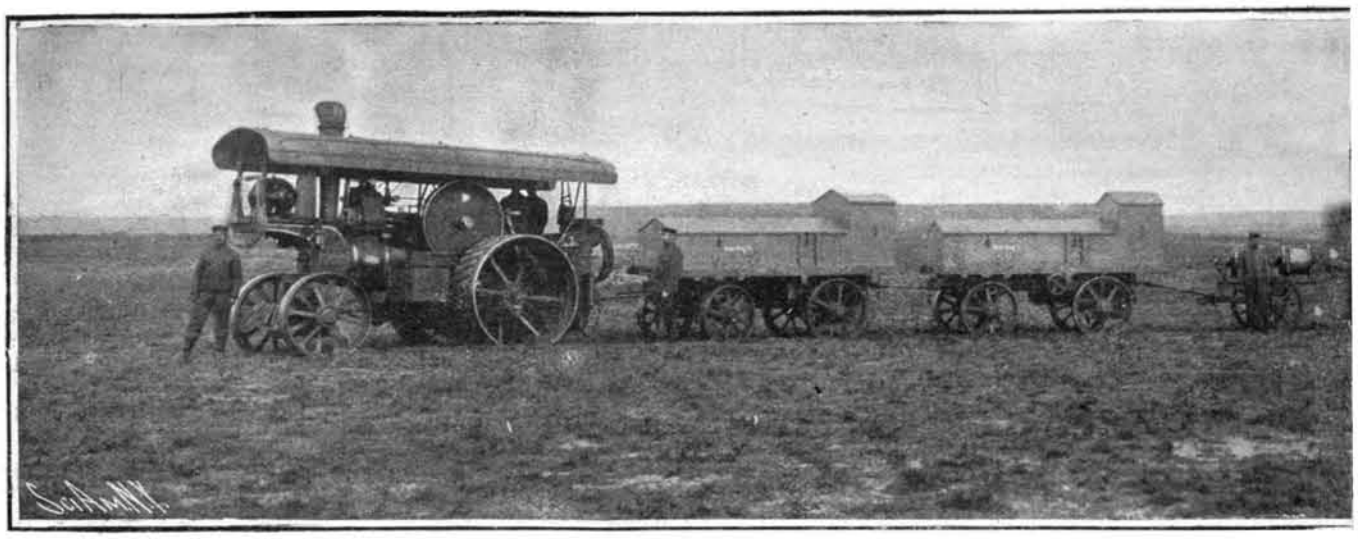
The water tank has a capacity of 190 gallons, and the coal tank accommodates 550 pounds of coal. The capacity of the engine is 30 I.H.P. The dynamo is a shunt-wound machine of a normal capacity of 10 kilowatts, with 1,250 R.P.M. and 230 volts.

Each battery van carries sixty cells located in hard-rubber boxes, held in two wooden trays with acid-proof lining.

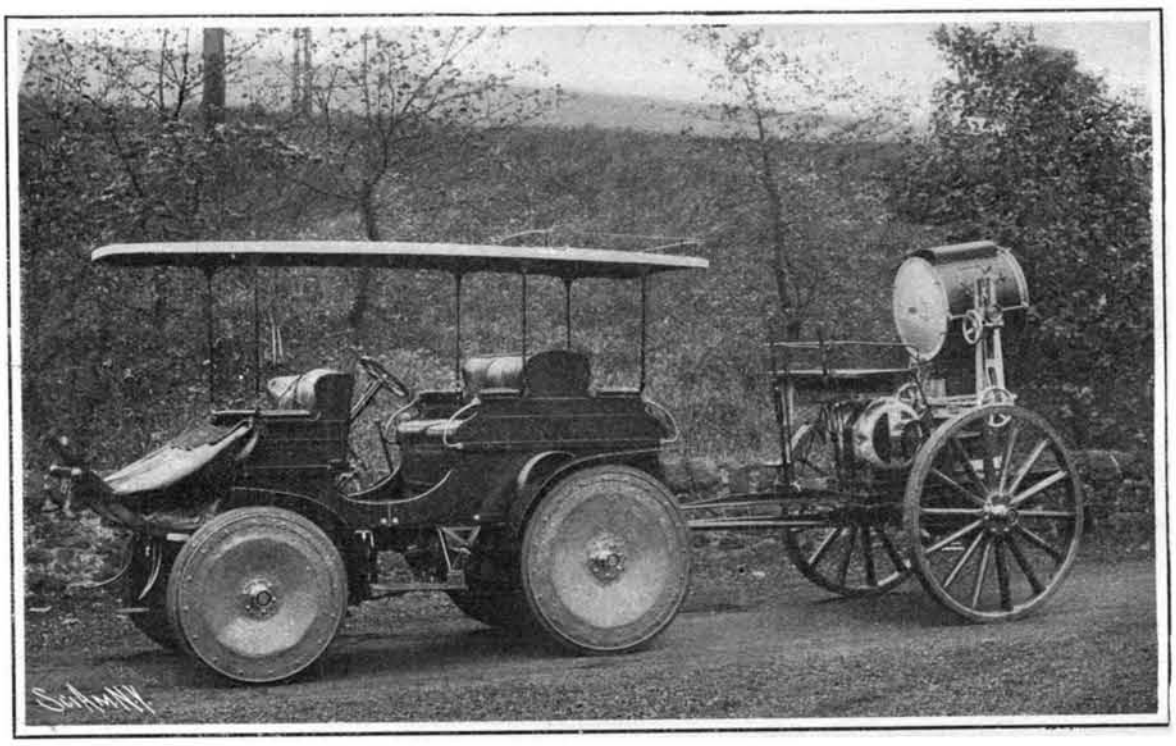
Each capstan van carries on a shaft located in five bearings four rope drums, each of which is able to receive about 8,200 feet of wire rope of ¼ inch diameter. An automatic device insures a smooth winding of the wire rope. The shaft of the wire rope drums is driven by two electric motors. The targets, which are moved forward, backward, or sideways at a speed corresponding with the conditions actually obtaining in real military operations, represent infantry, cavalry, and artillery. They are made of some light stuff such as pasteboard and linen, and are about the natural size of a man or a vehicle with its horses. They are carried on a sled, the upper frame of which is connected with the lower by hinges, so as to allow of its being turned around at a moment's notice, in case advancing or retreating infantry is to be represented. Special arrangements have been provided to cause the upper frame to drop as soon as the displacement is discontinued, while other targets representing riflemen become visible at the same time. The approximate speed of the targets is recorded by a tachometer driven from the drum shaft.

The whole outfit is used either combined or in two sets of one battery van and one capstan van each at two different places. In case cavalry targets are to be given a speed higher than 400 yards per minute, the dynamo will have to be resorted to, while accumulator battery operation is otherwise quite sufficient.

In one of our illustrations is shown a complete plant in course of transportation on the Münster (Hanover) proving grounds. Instead of the second traction engine this plant includes, however, an old petroleum locomobile, which is used only as a makeshift. The car behind the latter is a tool car, which is not required in the more recent plant described above, where any tools are arranged in special boxes. The traveling speed of a similar train obviously depends to a high extent on the conditions of the ground and weather, ranging in most cases between 10 and 25 miles per hour in the country. The same plant is represented in course of operation in a second engraving. The capstan cars are driven by the accumulator batteries, while the dynamos of both the road locomotive and the petroleum locomobile are at work supplying additional energy and instantaneously making up for any used-up current. It should, however, be remembered that the dynamos are resorted to only in exceptional cases.



A Complete Plant for Transporting Traveling Targets as Used by the German Army. S



An Automobile-Driven Field Searchlight Outfit.

THE KRIEGER SEARCHLIGHT AUTOMOBILE

The new Krieger car is of the type known as gasoline electric, in which the usual form of gasoline motor is applied in connection with an electric outfit. This combination gives several advantages. The principle of the new car is as follows: In the front of the chassis is mounted a gasoline motor which is direct connected to a dynamo. The latter is used to supply current to the motors which are mounted directly against the rear whe without usir tial, as ther for each wh tors are thus by the curr dynamo.

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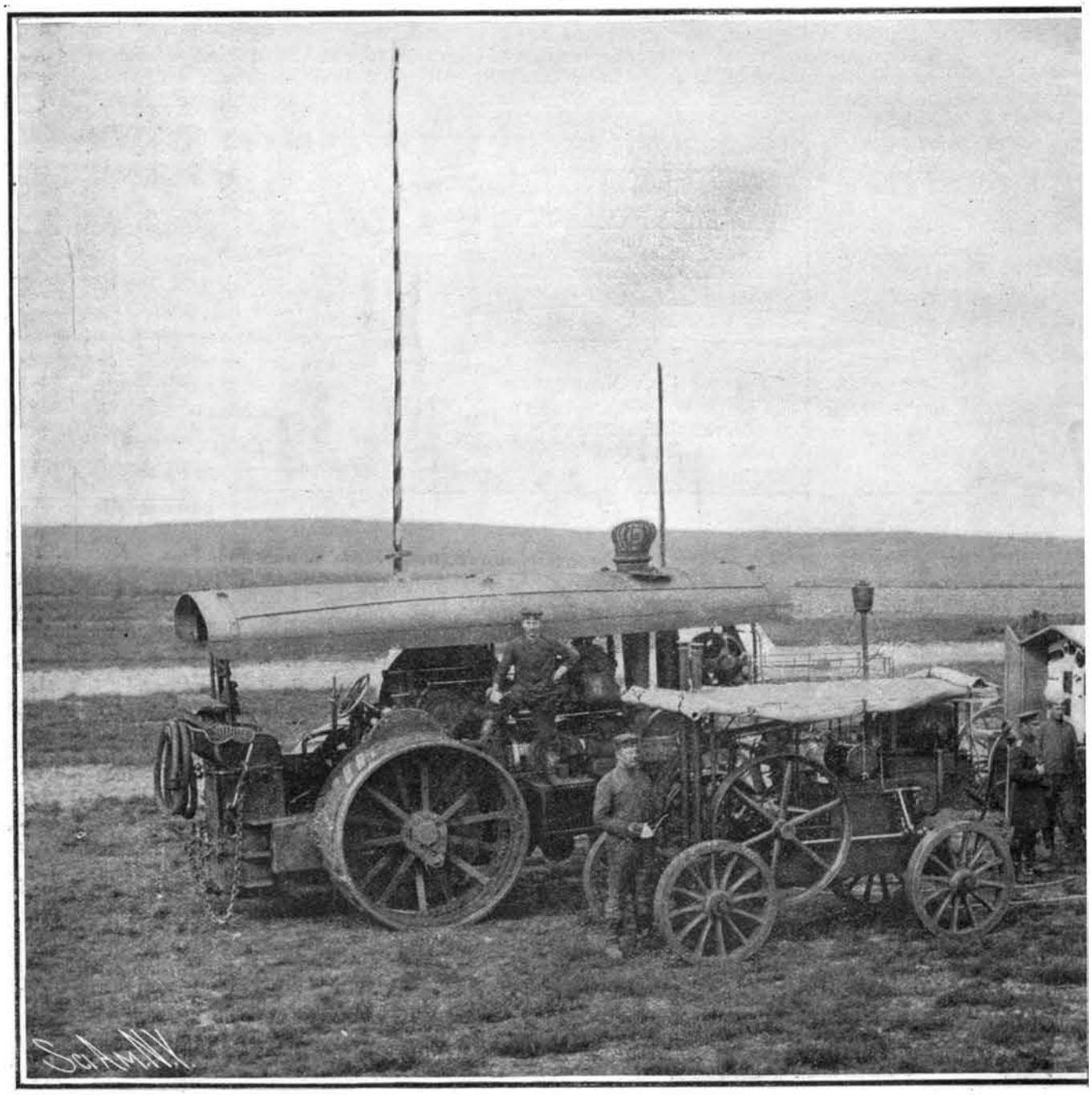
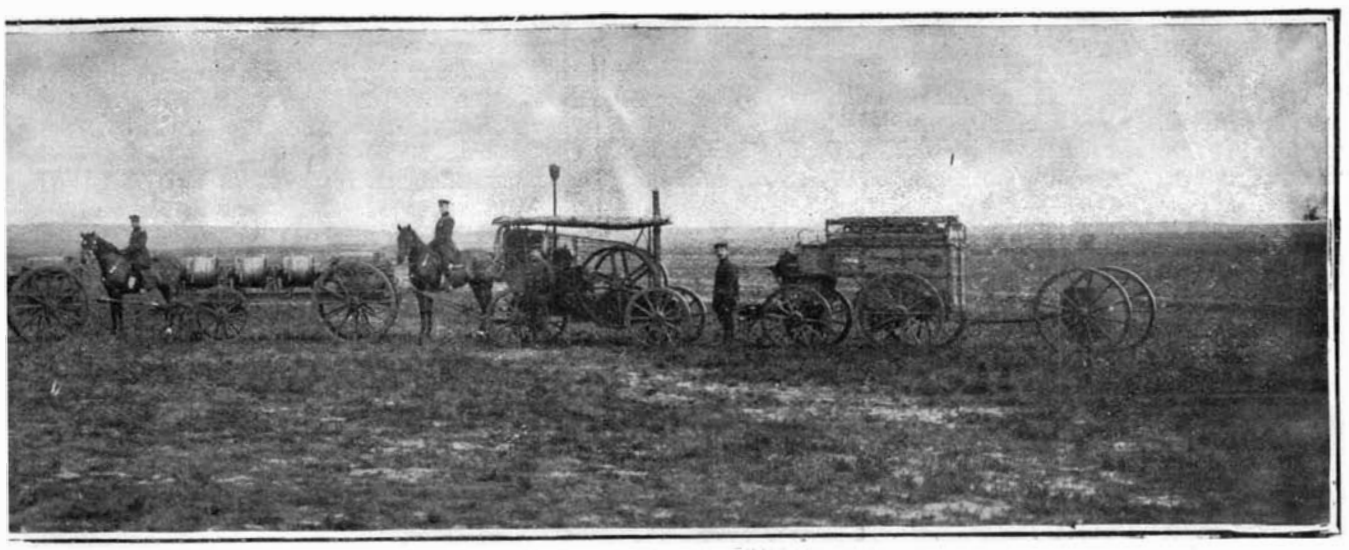


This Plant for Hauling Moving Targets Has a Speed That Varies from

ELECTRICALLY-DRIVEN TARGET



ecial Windlasses are Hauled, Carrying Wire Rope, to Which the Targets are Attached.

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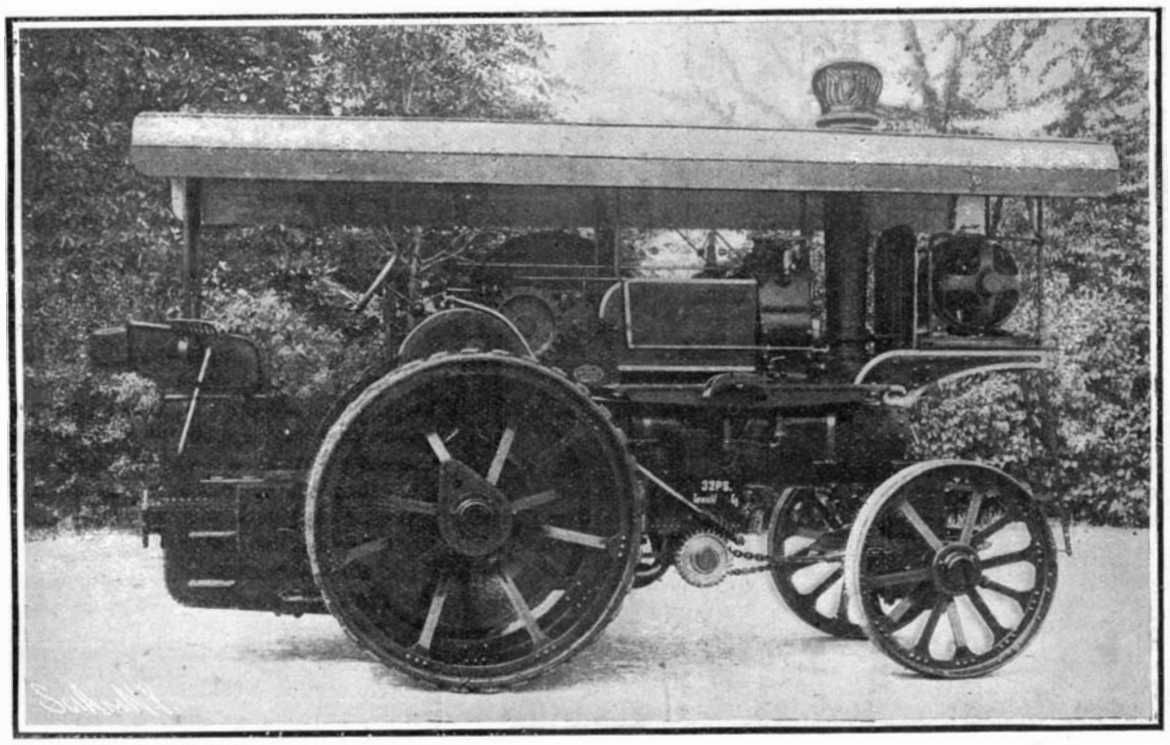
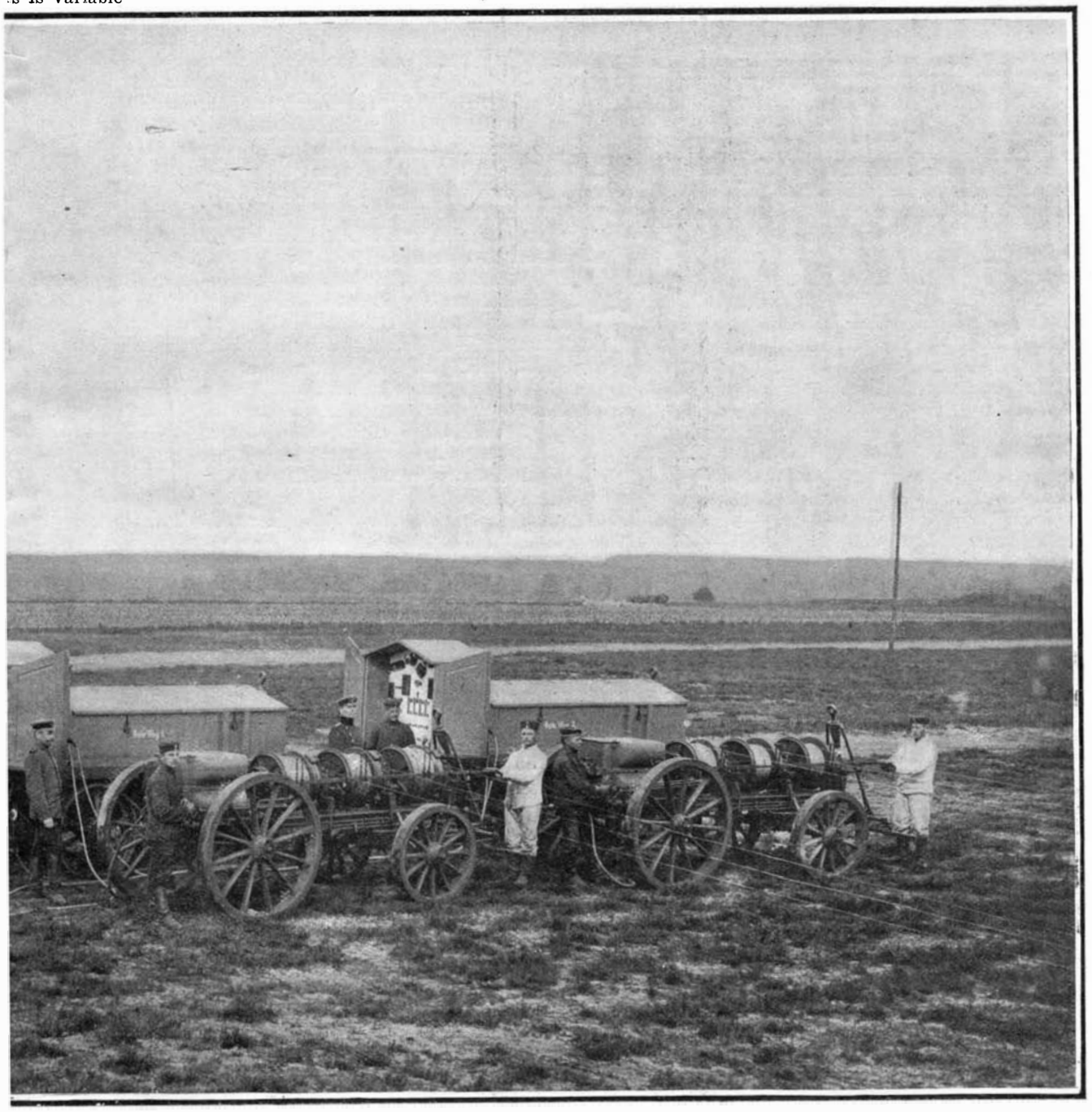


A Fowler Traction Engine Used for Military Purposes.



1 10 to 25 Miles an Hour, Depending Upon the Nature of the Ground.

TRAINS IN THE GERMAN ARMY.

and therefore the current varies in proportion, the electromotive force of the dynamo must be made to vary in the inverse sense from the current in order to keep the power constant. This is carried out by using a method of regulation upon the field magnets of the dynamo, which are provided with a separate winding for the purpose. The field of the dynamo is produced, in fact, by three different coils—first, a shunt winding whose effect varies with the electromotive force at the terminals; second, an independent circuit in which the current is supplied from a small storage battery of 60 pounds; and third, a special "demagnetizing" coil which consists of a few turns of a series winding upon the main current circuit of the dynamo. The automatic regulation of the field is carried out by the demagnetizing coil, which varies the electromotive force in the inverse sense from the current.

The storage battery serves to give a constant magnetizing effect and thus to avoid a possible absence of current which might result from an overload on the car, in which case the electromotive force might fall too low. It also serves at starting to set the motor group in movement by making the dynamo run as a motor, thus starting the car with no trouble.

To vary the speed of the car independently of the automatic regulation, we may act upon the gas inlet of the gasoline motor, thus cutting down the current of the dynamo. In this case the rear motors can be run down to a full stop, but the gasoline motor keeps on running, and the least increase of speed will set the electric motors working and start up the car. The above arrangement gives a much lighter car than an accumulator automobile, and it has a number of advantages, among which is an easy running of the car owing to the suppression of the gear-box, differential, and other mechanism. For the same reason the efficiency of the Krieger car is higher than for an ordinary gasoline car, and a series of careful tests showed it to be 80 per cent instead of 60 per cent for the latter. An interesting feature of the new car is that the motor and dynamo form a veritable electric plant which can be used to give current when the car is stopped, and this current can be used to light the premises, for instance.

Cost of Laying Dust.

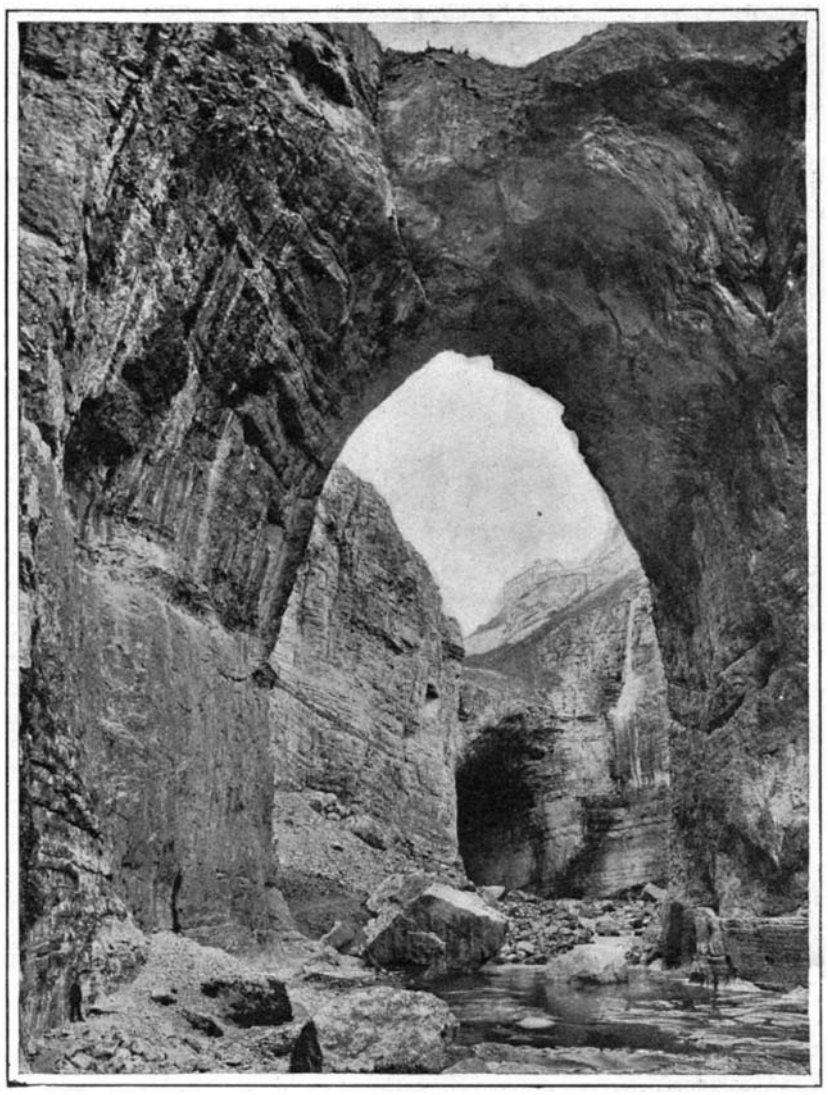
The Road Protection League, which has been formed in Europe for the purpose of promoting different questions relating to the suppression of dust and the tarring of roads, recently held a meeting at Paris. M. Guglielminetti, the secretary of the league and a leading authority on such matters, made some interesting statements on the question of applying liquid matter on the roads. According to the official reports of the government engineers of the city of Paris, the Department of the Seine and other districts, the four years test of the new tarring system has given excellent results from every standpoint and quite justifies the expense. The latter is estimated at $0.03 to $0.04 per square yard. On a main avenue of the town of Melun, among others, the annual economy resulting from the tarring process has been estimated at $0.02 per square yard on the decrease of wear and at $0.01 on the watering and cleaning of the road, so that in fact the cost of the new treatment is not over what the untreated road would cost, and we have the advantage of no dust or mud. Besides the usual processes of preventing dust, a new method has been brought out by a French chemist, P. Delair, and it can also be used for laying the dust inside of houses, where coal tar cannot be employed. The experimenter had occasion to make long researches on the use of chloride of magnesium for laying dust. It can be procured at a very low price. As it is very deliquescent, when in solution it is very slow in evaporating. Thus certain bodies which are impregnated with it are able to keep moist and thus will attract the dust and small debris of all kinds, keeping them down but without sticking. It seems well adapted for floors and also for roads on this account. Although it does not suppress the powdered matter, it gives it a certain density which prevents it from rising and dispersing different kinds of germs. A strong solution applied twice in two days is enough for treating a floor. After two hours the solution sinks into the wood. Then the sweeping can be done under the best conditions. The dust when raised falls again instead of flying into the air, and can be removed easily. In Europe the price of this treatment is only $0.006 per square yard.

Germany leads to-day in the manufacture and use of alcohol for light and power. In that country potatoes are the chief source from which alcohol is produced. The potato crop last year reached the astounding proportions of 1,775,579,000 bushels, or more than 53,000,000 standard tons. Of this amount nearly one-half was used in the manufacture of alcohol and starch. One-eighth of all the tillable land in Germany is planted to potatoes, which show an average production of 217 bushels an acre, which sold at an average of 27.6 cents a bushel, or about $60 an acre. In France alcohol for manufacturing purposes is made chiefly from molasses and sugar beets.

AN ALGERIAN NATURAL BRIDGE.

In considering the great natural bridges of the world, we are probably most familiar with the one in Virginia, which geologists believe has been formed by the collapse of a wall of a cave. In the State of Utah is another formation of this kind, which is of very large proportions. It is but little known, however, for the reason that it is far removed from the nearest railroad or highway. But comparatively few have visited it.

One of the most extensive bridges in the Old World is that illustrated in the accompanying photograph. It is located in Algeria, North Africa, and in the vicinity of the hill town of Constantine. Here the rock formation is so friable that it has disintegrated on an enormous scale, forming what would be called in America canyons and caves, besides the bridge in question. The opening formed by the archway of the bridge is several hundred feet in height, and over 250 feet in width at the point where the archway is of greatest dimensions. At the right of the picture will be noted the ruins of an ancient stone wall, which was probably used to support a highway beneath the bridge.



ONE OF THE GREAT NATURAL BRIDGES OF AFRICA.

A NEW FISH FOR AMERICA.

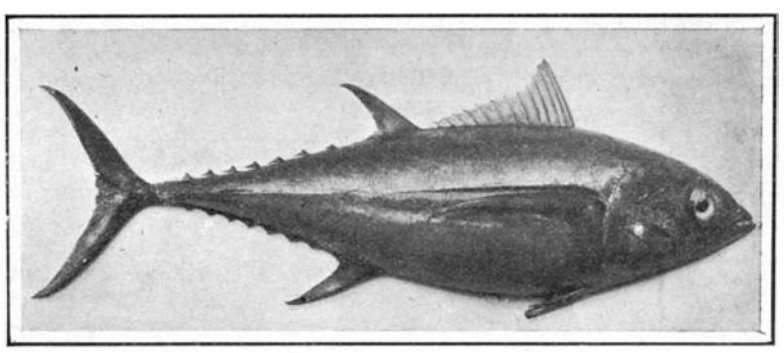
BY CHARLES FREDERICK HOLDER.

A very interesting episode occurred recently on the Southern California coast. A new and entirely unknown fish in America suddenly appeared in great quantities, and in the language of Dr. D. S. Jordan, who was the first to recognize the stranger, "added another link between America and Japan."

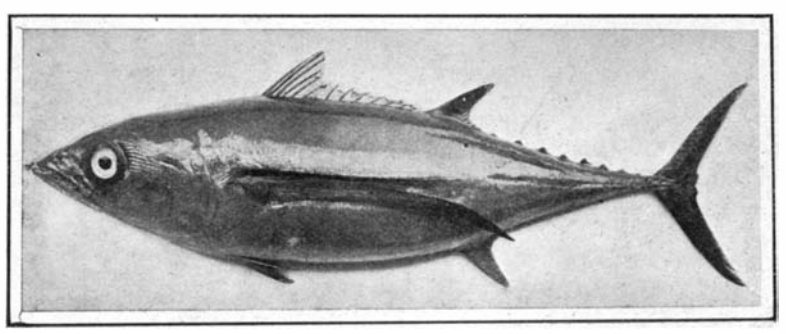
The fish was the Japanese yellow-fin albacore, shown in the accompanying illustrations, also known in Japan as the Hirenaga (*Germo macropterus*). It has been found for years in certain parts of Japan and the Hawaiian Islands, but never in this country. For some reason a large school wandered to Southern California islands, where for several months it afforded a harvest for boatmen and market fishermen. All the fishes taken averaged about fifty pounds in weight, were about three and a half feet in length, and bore a striking resemblance to the tuna or horse mackerel, the head especially being like it, and the body deep, like that of the larger fish. In other respects the fish resembles the albacore, the arrangement of the fins being very similar, the tail and finlets much alike in both fishes. The cheek or operculum in the albacore is the longest; the mouth or snout the most pointed.

The remarkable characteristic of the albacore, which is also illustrated herewith, is the extraordinarily long and swordlike pectoral fin, that reaches from the ventrals to beyond the anal. In the Japanese fish the pectoral fins have remarkable length, though by no means as long as those of the albacore, reaching to the front of the dorsal, being about the length of the dorsal. The Japanese albacore has nine or ten finlets which are a vivid lemon yellow, quite different from the tint observed in the tuna; hence the name, "yellow-fin albacore." In a general way the fish resembles the tuna, but with the side fins of an albacore, so that the casual observer or layman would believe it to be a link connecting these two fishes, a composite of albacore and tuna.

The islands of Southern California have been under intelligent supervision for fifty years, but never before has this interesting fish been reported, and as it is a choice market and splendid game fish, it is to be hoped that it will return every year.



Japanese Yellow-Fin Albacore, Which Appeared at Santa Catalina Island in 1906, for the First Time in America.



The Pelagic Albacore.

A NEW FISH FOR AMERICA.

It is stated that two hundred and thirty-one municipal acetylene plants are now in use in the United States.

Panspermy: The Transmission of Life from Star to Star.

BY PROF. SVANTE ARRHENIUS.

In 1903 I pointed out that the theory which has been called panspermy, according to which the germs of organic life are conveyed through interstellar space from one heavenly body to another, had gained greatly in probability from the establishment of the pressure exerted by light and other radiations as a demonstrated cosmical phenomenon. Since that time I have developed this view, which I present in more complete form in this article.

The theory was suggested by the failure of repeated attempts made by eminent biologists to discover a single case of spontaneous generation of life. The alleged discovery of albuminous substances on the sea bottom created a sensation in its day, and to the unknown organism which was supposed to have produced the albumen Huxley gave the name *Bathybius Haeckelii*. But the flocculent precipitate formed by adding alcohol to the sea water was subsequently proved to be not albumen, but sulphate of lime. Dr. Burke's "radiobes"—alleged organisms created by the action of radium on gelatine—have been demolished by Ramsay's criticisms, and a similar fate has befallen all other reported examples of spontaneous generation.

In 1871 Kelvin adopted the theory of panspermy, and expressed the conviction that the impossibility of converting lifeless into living matter without the aid of already living organisms is as securely established as the law of universal gravitation.

A great difficulty of the theory has consisted in the apparent impossibility of conveying germs even from one planet to another in a time through which their life could be preserved. Most germs can be kept alive only a few years, though some, including certain spores and the hard-shelled seeds of leguminosæ, retain the power of germination for several decades. A body moving with the speed of a railway train, 60 kilometers (37 miles) an hour, would occupy 150 years in going from the earth to Mars, and 70,000 million years in making the journey between the solar system and the nearest fixed star, Alpha Centauri. By introducing the pressure of radiation as a motive power these intervals may be reduced under favorable conditions to 20 days and 9,000 years respectively, as I showed in my previous article.

But even these intervals may appear to be of formidable length, especially in view of the absolute dryness and intense cold and light to which the germs would be subjected in transit.

Microscopic organisms differ greatly in susceptibility to the effect of light. Duclaux has shown that *Tyrothrix scaber*, which occurs in milk, can endure a month's exposure to bright sunlight, and Roux has proved that the energetic destructive action of light on the germs of splenic fever is dependent upon the presence of air, so that they are not injured by light in a vacuum. It appears, therefore, that light acts by means of a "photochemical" process of oxidation.

It has been demonstrated that intense cold is not injurious to all germs. Macfayden kept spores of bacteria at —200 deg. C. (—338 deg. F.) for six months, without injuring them appreciably. Probably the effect of cold is preservative rather than destructive. The diminution and ultimate loss of germinative power is certainly due to slow chemical changes. Now the rapidity of chemical processes decreases very quickly as the temperature is lowered. In the case of those vital processes that have been investigated a fall of 10 deg. C. (18 deg. F.) reduces the speed of reaction in the ratio of 5 to 2. The loss of vitality in interstellar space, at a temperature of —220 deg. C. (—364 deg. F.) would therefore be more than one thousand million times less rapid than the loss at 10 deg. C. (50 deg. F.); so that a journey of three million years through space would be no more injurious than a single day of exposure to terrestrial spring temperature. In the journey between the earth and Mars the temperature would be a trifle higher owing to the proximity of the sun, but the trip would occupy only a few months and the germs could survive.

The rapidity of the photochemical changes induced by light and the rapidity of desiccation would be similarly diminished by cold. Schroeder has proved that two algæ containing much water, *Pleurococcus* which grows on trees, and *Scenedesmus*, which lives in water, are not killed by being kept for 20 and 16 weeks, respectively, in a desiccator over concentrated sulphuric acid. These are vegetative organisms. It is probable that spores and seeds would survive much longer desiccation. Now it is natural to assume that desiccation, or evaporation, would be proportional to the vapor tension of water. The latter has not been directly measured at —220 deg. C. (—364 deg. F.) but it can be computed with sufficient accuracy from the latent heat of vaporization with the aid of a formula given by Van't Hoff. The result is similar to that already obtained for the loss of vitality, that is to say, desiccation advances no further in millions of years at —220 deg. C. (—364 deg. F.) than in one day at +10 deg. C. (50 deg. F.).

Hence we may perhaps conclude that the preservative effect of the low temperature of interstellar space assures the possibility of the conveyance of living germs from one solar system to another.

It appears not improbable that interstellar space is traversed, at enormous speed, by living germs which bring organic life to planets as soon as a crust capable of sustaining life has been formed.

Therefore spontaneous generation is unnecessary, as life can be transmitted from one heavenly body to another by minute germs propelled by the pressure of light. This idea involves another, which appeals to me very strongly, namely, that all organisms in the universe are related and the process of evolution is everywhere the same.—Translated for the Scientific American from Umschau.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

BUST-SUPPORT.—J. BREE, Charlottenburg, near Berlin, Germany. This support differs from the usual corset in that it can be worn without any injury to health. It consists of two back-plates or frame-pieces. These plates are connected together in any suitable manner, and to them the other essential parts of the support are attached, so that when wearing the same neither the breasts nor the stomach nor the liver are tightened in by lacing.

GARMENT HANGER AND LOCK.—J. C. EPLER, Philadelphia, Pa. One purpose of the invention is to provide a hook adapted to receive a coat or like garment and a hat, together with a chain, whereby to hang a bag, and also a clamping device for umbrellas and canes and means for locking the wearing-apparel and an umbrella or cane in their supports, which means are simultaneously operated to lock or release the articles by the action of a single, preferably key-controlled, lock.

PIN-RETAINING DEVICE.—R. FISCHER, New York, N. Y. The invention in this case is the provision of a device for holding a pin in the position in which it may be placed in a fabric or garment until purposely removed by the wearer or other authorized person and to so construct the device that it will be light, simple, strong, and easily operated to lock the pin or release it.

GARMENT-FASTENER.—W. A. NICKLESS, New York, N. Y. In the present patent the purpose of the invention is the provision of a very light, simple, economic, and neat device especially designed as a hose-supporter or in connection with suspenders and one which can be quickly and conveniently operated.

Electrical Devices.

CABLE-HANGER.—B. H. SKINNER, Canton, Ohio. This improvement relates to means for suspending cables used for telephone or telegraph purposes from a supporting-wire; and the object thereof is to provide a hanger which is easy to secure in place, which may be shortened or elongated, as desired, and which is exceedingly simple in construction and inexpensive.

INSULATOR FOR LEADING-IN CABLES.—L. STEINBERGER, New York, N. Y. Mr. Steinberger's invention has reference to insulators, and more particularly to a type of insulator for leading-in cables and other conductors and admitting of use generally wherever it is desirable for a conductor carrying a high-potential or heavy current to pass through a wall, roof, or partition of any kind.

Of Interest to Farmers.

DRAFT-GEAR FOR AGRICULTURAL MACHINES.—J. TILLY, Ladysmith, Kilkerran, South Australia, Australia. The invention has been designed especially to lessen the side draft of a stripper or stripper harvesting-machine, thereby enabling a greater number of horses to be attached abreast, without walking in the crop. It may be applied also to any other agricultural machine having a body which is oscillated upon the main axle and draft attached to a platform at one side of the oscillating body.

REELING AND UNREELING ATTACHMENT.—A. J. DETERMANN, Beresford, S. D. The invention contemplates the production of a means which is to be attached to a wagon or like vehicle-bed and operated from the wheel thereof. It is especially adapted to the reeling and unreeling of barb-wire in constructing fences, which is difficult to perform by hand, but may be used with advantage for winding other forms of wire, particularly those employed in fence construction.

Of General Interest.

ICE-CRUSHER.—O. T. LARKIN, Plattsburg, N. Y. The invention pertains to improvements in hand implements for breaking or crushing ice to any degree of fineness, the object being to provide a device of this character that will be so arranged that the clogging of fine ice between the breaking or crushing blades will be prevented.

COFFEE-SEPARATOR.—R. F. CORDERO, Rubio, Tachira, Venezuela. This invention refers to improvements in separators or sizers for coffee-beans or other material the grains of which are of different sizes or specific gravity, the object being to provide a separator by means of which the work may be rapidly carried on, with the complete separation of the material as to size.

PLANIMETER.—E. McC. SCOVILLE, Waipahu, Ter. of Hawaii. The principal objects of this improvement are to decrease the expense of construction and the number of parts of instruments of this character, to provide for additional smoothness, and to provide means for supporting a number of scales in a convenient position in such a manner that it will not be necessary to replace the scales in operation.

WIRE-STRETCHER.—O. C. A. SCHWIEN, Davenport, Iowa. In this inventor's former patent, he employed a lever having a curved and toothed portion adapted to engage a fixed post and provided with a wire-grip located between the post and the handle end of the lever. This grip traveled on the curved portion of the lever in stretching the wire, such travel occurring when the lever was swung around the post. In the present invention he has adopted an arrangement, construction, and combination of parts whereby the power and efficiency of the stretcher as a whole are increased and the weight and cost of the same reduced.

PAPER-HANGER'S TRESTLE.—J. R. KINGSLEY, New York, N. Y. The purpose of this invention is to furnish a trestle especially adapted for paper hangers' use and which may be set up in a hallway, utilizing the stair-rail and banisters as a support. A further purpose is to provide a device which will be light and strong and which may be compactly folded up and conveniently placed in position for service.

EXCESS-BAGGAGE COUPON-CHECK.—F. H. CRUMP, Los Angeles, Cal. This check is used in combination with any ordinary baggage-check and is characterized by improved construction and novel means of attaching or associating same with the ordinary strap check or shell so that after being attached the excess coupon-check can be opened or unfolded in order that one or more coupons may be removed by the baggage-man.

MOLD.—H. BESSER, Alpena, Mich. This device makes brick, blocks, and other plastic material. The principal objects are to so arrange the parts of the mold that they will recede from the concrete without sticking to it or injuring the same, all parts being drawn away from the beginning of the movement thereof, also to provide means for opening, closing, and locking the mold, and also to provide means for guiding the molding material into the mold and guiding a tamper-tool. Mr. Besser has invented another mold, the principal objects of the invention being to provide means whereby the blocks can be molded face down, the cores withdrawn vertically after mold has been filled and turned over on the pallet; to provide for automatically taking up the pallets and locking them to the mold, and depositing the molded articles on the pallets, and to provide means whereby various parts of the mold can be separated from the molded article without injuring the surface thereof.

RACK FOR TISSUE-PAPER AND THE LIKE.—W. A. BLACKMAN, New York, N. Y. In this improved rack any of the different kinds of paper may be removed without displacing any of the other kinds, and the removal or insertion of paper does not destroy or injure in any way the paper already on the rack. All of the different kinds of paper are exposed to view, and any color may be selected without disturbing any other sheet or color.

HOLDER FOR PAPERS OR BAGS.—GERTRUDE S. PRIDDY, Chicago, Ill. In this case the invention relates to a device for clamping and holding a plurality of sheets of papers or bags; and one of the objects is to produce a device from which the papers or bags may be readily removed one by one without tearing them, and at the same time they are held secure against accidental displacement or removal.

AUTOMATIC STEAM AND HOT-WATER SAFETY-COCK.—J. A. FREY, Washington, D. C. The cock is for use as an attachment of domestic water-heaters and steam boilers or generators for relieving pressure of steam when it exceeds a predetermined limit of safety. It is adapted for use in the usual way for discharge of water from a heater or boiler, the automatic feature being additional or supplemental and adapted to come into action only when the usual turning spigot is closed or adjusted to cut off discharge.

DIPPER.—C. F. SMITH, New York, N. Y. In dipping milk from cans after the can is almost empty it is impossible to use an ordinary form of dipper, for the reason that the handle of the same cannot be turned to bring the cup of the dipper to a horizontal position, in which it is most readily filled. The inventor overcomes this objection by providing means to swing the cup to a vertical or horizontal position, said means being operable by the hand holding the dipper.

MARKER FOR BUST-FORMS.—A. WATERMAN, New York, N. Y. One purpose of the invention is to provide a device particularly adapted for use in connection with bust-forms, wherein the marking-arm of the device may be swung around the form and adjusted vertically and laterally, thus enabling any portion of the form to be conveniently and expeditiously reached to mark the garment placed upon it.

METHOD OF MAKING BRUSHES.—J. MORRISON, Troy, N. Y. The invention relates more particularly to a method of assembling and constructing brushes. By this method comparatively inexpensive machinery may be used, and the operation is very simple. The die member, which is made, preferably, of metal and provided with bristle holes or apertures, disposed radially, taken together with a simple means for applying a general pressure, is the only mechanism needed. This die member is in effect a simple form of mandrel.

COLLAPSIBLE DAM.—W. W. JONES, Granada, Col. The invention relates to dams designed to be used for many special purposes, but particularly in connection with irrigating canals and ditches. The collapsible dam is intended to be far more effective than the solid, and much cheaper in construction, for the reason that the stationary dam requires more than double the width of the bed, longer piling, and must be made doubly strong to withhold a first flood coming down stream.

MANUFACTURE OF VARNISHES, BALSAMS, AND RESINS.—A. KRONSTEIN, Karlsruhe, Baden, Germany. This process is of considerable importance in avoiding complicated and expensive purifications, and in affording a much greater field. The manufacture is carried out in such manner that the substances to be thickened or the mixtures of several oils are heated, preferably, in closed vessels—that is, practically under exclusion of air in a moderate temperature below that at which decomposition commences.

FEED-BAG.—W. H. ROBINSON, New York, N. Y. A feed-bag is provided consisting of a tray from which the animal takes the feed, one or more receptacles for storage of feed and having valve-controlled outlets leading to the tray, and means for opening the valves when the bag is in position upon the animal, whereby the animal can not only feed and have its nostrils exposed, but whereby also the feed is fed to the tray as needed, thus obviating waste.

PROCESS FOR COOLING COKE.—C. E. ARNOLD, Wilmington, Del. The improvement has reference to a process for cooling or quenching coke after it is removed from the coke-ovens, and comprises the employment of certain steps by which the temperature of the coke is rapidly reduced and combustion prevented even while the coke is at a high temperature.

TABLE.—A. P. SWITZER, New York, N. Y. Mr. Switzer's invention relates to tables, and especially to those adapted for the support of such machines as typewriters. Its principal objects are to provide a table which may either hold the machine in position for use by the operator or which may be shifted with minimum effort to leave the forward portion of the table-top free for other purposes.

MOLDER'S FLASK.—G. H. RAYBURN, Columbus, Ohio. By means of this device the impression in the sand of the article to be cast may be expeditiously and perfectly formed. The invention consists of a cope and a drag capable of being opened laterally, combined with a pattern-board adapted to form a partition therebetween, the whole being provided with effective means for holding them in perfect register or for holding the cope and drag in register only.

BLAST-FURNACE.—H. W. HIXON, Victoria Mines, Ontario, Canada. The main features of the furnace comprise a lining of refractory material, and an air-jacket constituting a substitute for the water-jacket formerly used and through which the air passes on its way to the twyers. Greater economy in fuel to smelt the charge is obtained, as all of the heat transmitted through the lining is employed to heat the air in the air-jacket, and this heat is again returned to the furnace proper as the air enters the twyers. When a water-jacket is used, all of the heat transmitted through the lining is carried away by the water and lost. The furnace saves all of this heat.

MOLD FOR CONCRETE CONSTRUCTION.—J. F. SWINNERTON, New York, N. Y. A plurality of strong frames is provided which can be readily attached to provide molds of any dimension and detached after use and repeatedly used in concrete construction. This permits the frames forming the molds to be packed in small compass and easily carried. The frames are made of wood and built so that distortion from moisture is reduced to a minimum and are covered on their inner faces with sheet metal, giving a smooth surface to and avoiding rapid and injurious waste of water from the concrete as the latter dries out.

AUTOMATIC VALVE.—C. A. DUNHAM, Marshalltown, Iowa. The invention relates to a valve arranged automatically to close in the presence of heat. It is useful in many connections, particularly as applied to the return ends of radiators in vacuum heating systems. The valve permits the air and water of condensation to flow freely from the radiator; but as steam begins to flow from the valve it will be closed and the movement of the steam arrested.

Hardware.

LOCK.—O. KATZENBERGER, San Antonio, Texas. The object of the inventor is to provide a lock so arranged as to be opened by a key from the outside of the door or by the manipulation of a combination on which the lock may be set, and, further, so constructed that the lock may be opened from the inside without employing a key or operating the combination.

HEATING AND LIGHTING.—L. H. THURSTON, Belt, Mont. The improvement is in the nature of a new heating-stove, applicable for heating stoves and furnaces of all kinds, and to which is given the name of "oxygen blast." It is designed to secure a more economical use of fuel, a thorough heating of the lower stratum of air in the room, and a perfect ventilation of the room with removal of foul air.

Household Utilities.

AUTOMATIC ALARM.—P. BOURNE, New York, N. Y. One purpose in this case is to provide an alarm device applicable to windows and which can be readily set at the right-hand or left-hand side of a window, the device being adapted for attachment to the lower sash and for rack or frictional engagement with the upper sash, whereby the upper or lower sash, under ordinary conditions, cannot be raised or lowered without sounding an alarm.

FLUSHING-VALVE.—W. S. WHITE, Denver, Col. The invention refers to a valve or mechanism which is applicable to various purposes. The object is to provide a mechanism which will be certain of operation under different conditions and which may be regulated to increase or diminish the flushing period, as may be desired. A float-valve is employed which is adapted to be manually raised into open position, so as to permit the water to flow through the device, and which is gradually deprived of its buoyancy, so that the float-valve may in time return to its seat and cut off water-flow. The longer the time taken in returning the valve the longer the period during which flushing operation continues.

CARPET-STRETCHER.—J. DRIVER, San Leandro, Cal. The teeth are set at the requisite distance from the carpet edge, and the device placed upon the carpet. By steady pressure or by a succession of blows with the knee, the operator forces the device forward until the carpet is stretched as required. Powerful pressure may be easily applied in this manner, and the two sets of claws or teeth take a firm hold on the carpet, the latter not liable to be torn or injured.

SERVING-TRAY.—C. A. WEISS, New York, N. Y. One purpose of the invention is to so construct the tray that a series of objects and receptacles are carried by a common base and to so group the objects and locate the fastening devices for the tray that when the tray is secured upon the table or other support it will occupy no more room than usually required for a single object. It can rest or be freely moved upon a table and is provided with means for attachment to tables of varying depth of top board.

WASHING APPARATUS.—F. H. COLE, Groveton, N. H. Broadly, the invention comprehends a peculiar nozzle, having a suitable handle, a water-supply pipe connected with the nozzle passage-way, a cut-off valve for the control of water, a sponge, brush, or similar scrubbing means, and peculiar means for support thereof, in front of the discharge opening of the nozzle. It is designed for washing cars, windows, etc.

ADJUSTABLE WINDOW-CHAIR.—D. S. LEGER, Lynn, Mass. The chair is adapted to be secured to a window-sill and upon which chair a person may sit when cleaning the outside of the window. All liability of accident when sitting or standing on the sill is entirely eliminated. The chair may be secured very quickly and requires no special skill to adjust it to fit the window.

SELF-CLOSING VALVE.—N. NILSON, New York, N. Y. The valve is useful in connection with devices adapted for flushing closets, urinal-bowls, and the like. The object is to provide a valve which may be operated manually to permit the flow of water through the same, and which automatically closes the inlet to the valve in a gradual manner, permitting a slow afterflow. The inlet is closed through the rotation of a motor actuated by the flow of the water and which rotates a cam-wheel adapted to close the inlet-valve.

Machines and Mechanical Devices.

WEFT-REPLENISHING MECHANISM FOR LOOMS.—L. MILLER, Yonkers, N. Y. In weaving operations the contents of the shuttles soon become exhausted, and frequently it is necessary to stop the operations of the loom in order to substitute another. The object of the invention is to provide an arrangement whereby another shuttle may be substituted for the one in use without necessitating the suspension of the weaving operation.

CLUTCH.—T. J. FAY, New York, N. Y., and J. M. ELLSWORTH, Bernardsville, N. J. This invention relates to certain improvements in clutches, and particularly clutches designed for use in transmitting power from the driving member to the driven member of motor-vehicles; and one object is to provide a clutch of small diameter, whereby the weight is very materially reduced and whereby a flywheel fan is employed.

HOISTING APPARATUS.—F. D. MILLIN, Spokane, Wash. This apparatus is to be used in lifting brick, beams, and other forms of building material, also in extracting stumps, stretching wires, and where a pulling strain is necessary. It can be readily moved from place to place under the action of its own power and employed to drive hoisting apparatus or the carriage on which the machine is mounted by the will of the operator, combined with suitable means to anchor the machine when used in the hoisting operation.

TRAINING-MACHINE.—E. BROWN, St. Louis, Mo. The invention refers to that type of machines in which an inflated bag is suspended in a position where it may be repeatedly struck by a person employing a machine; the object being to provide a device in which the bag may freely swing back and forth, as in the common form of training-machines of this character, but in which the point of suspension may also move about and give the person added exercise.

TIME-RECORDER.—J. G. WYNN, Madison, Wis. The invention admits of general use, but is of peculiar value in factories, stores, and similar institutions in which it is desirable to make records of time of employees. It relates more especially to mechanism for cutting time-cards so as to note in contrast with each other the respective times for beginning and finishing different pieces of work.

TYPE-WRITER ATTACHMENT. — W. C. PLANK, Las Flores, Mexico. The principal object of the invention is to provide means for allowing the carriage to move varying distances according to the letters struck, so as to provide a uniform spacing between the adjacent letters instead of between the centers of the letters. This will greatly improve the appearance of the work, and it is accomplished without greatly modifying the construction of ordinary machines and permits the use of regulation printing-type; and use of capitals without striking the spacing-bar afterward.

TRANSMISSION MECHANISM.—J. J. TROEGER, Chicago, Ill. The principal objects of the invention are to provide for obtaining the same number of different speeds in both the forward and reverse motion with the use of fewer gears than are ordinarily used in reversing and varying speed devices; also, to provide a device which will give additional speed in both directions by the simple addition of two gears; also, to so construct a device that all the gears can be placed in an oil-tight case, and readily lubricated.

SPEED-INDICATOR.—L. L. B. DENIS, 135 Boulevard Menilmontans, Paris, France. The device is so constructed as to indicate even at a distance the speed of a part to which a rotary motion is imparted, such speed being expressed, according to the applications, either by the number of turns per minute in the case of a machinery-shaft, or, for instance, in the case of a motor-car by the journey run by the rim of the wheel within a given unit of time, miles run in an hour, etc. It can give the number of pulsations per minute made by a part having a reciprocating motion and operated by a crank.

DRIER.—R. F. CORDERO, Rubio, Tachira, Venezuela. This invention pertains to improvements in driers for coffee, cereals, fruit, etc., an object being to provide a device by means of which the material may be rapidly and thoroughly dried. When the drier is used for drying fruit or the like, the several plates which are designed to prevent the passage of hot air to the middle portion of the drier-section when the drier is used for coffee, cereals, or the like, are removed.

TRANSMISSION MECHANISM.—F. STRICKLAND, Muskogee, Ind. Ter. The object of this inventor is to produce a mechanism which will operate to transmit power at a varying-speed ratio. It is applicable in connection with many machines having a reciprocating part which does work on one stroke only. By means of the invention the return stroke is made at a greater speed, so that the power is most advantageously applied to the work.

THEATRICAL APPARATUS.—R. F. STALEY, Rochester, N. Y. The object of the improvement is to provide certain improvements in apparatus whereby a group of stage properties representing a set of articles belonging to one scene may be almost instantly transformed to a set of different articles belonging to an entirely different scene—for instance, changing a scene representing a cooper-shop to one showing the interior of a room—the transformation taking place without changing the position of the properties on the stage.

TYPE-WRITER.—E. B. PIERCE, Alameda, Cal. The invention more particularly relates to mechanism for returning the carriage to its initial position and for advancing the platen. Its principal objects are to provide means for effecting the reversal and feed, either automatically or manually, with minimum effort on the part of the operator, and in either case to effect this speedily and with little shock upon the machine.

COTTER.—T. F. MCANDREWS, Cohoes, N. Y. In this case the invention has reference to cotters used on motion-rods using a taper key or gib; and its object is to provide a new and improved cotter arranged to eliminate the possibility of losing the rod-key when the gib is set out properly against the rod.

PHOTOGRAPHIC-PRINTING MACHINE.—J. F. JUNGKIND, Little Rock, Ark. There is provision in this invention for conveniently turning on and off the light at the desired times; for also manipulating a red light in a most convenient manner, so that it will always be lighted when desired and extinguished when not needed; to provide for printing both from plates and from films, and further, to provide for holding the printing-paper in contact with a negative.

FEED-REGULATOR. — G. HALLIDAY, Superior, Wis. The invention is an improved feed-regulator for the feeding of grain and other materials in a broad, thin, and continuous stream. The invention contemplates a device which shall be an effective means for positively distributing grain uniformly and at any desired rate.

HAND DEVICE FOR OPERATING SEWING-MACHINES.—MILDRED J. RAPIER, Beaumont, Texas. The aim of this improvement is to provide a device which shall be capable of rapid and easy adjustment, whereby it may be put into combination with the drive-wheel of a machine to enable persons who through illness, accident, weakness, etc., are incapable of operating the ordinary foot-treadle of a machine to operate sewing-machines by hand-power.

ACETYLENE-GAS GENERATOR. — B. W. SCOTT, San Jose, Cal. The intention in this improvement is to provide an apparatus for generating gas from carbid which will be simple, compact, and thoroughly safe and so constructed that the feed of carbid may be made automatic when desired, but wherein the feed of carbid at all times will be under the control of the attendant.

MOLDING-MACHINE.—H. BESSER, Alpena, Mich. The objects of the invention are: to quicken the closing of the mold, so as to save time; to render certain parts of the mold as nearly as possible automatic in their movements; to enable blocks to be molded directly upon the ground or similar surface, so that the blocks when finished will continue to occupy positions originally occupied by the material of which blocks are made, and to facilitate the construction of waterproof blocks. Mr. Besser has invented another molding-machine in which the more particular object is to produce a type of machine suitable for molding bricks and blocks of concrete or other plastic material and from which the molded blocks may be readily detached.

Medical Appliances.

DENTAL FLOSS-HOLDER.—C. M. OVERBAUGH, Clarion, Iowa. This invention refers to improvements in holders for floss employed in dentistry for cleaning between the teeth, the object being to provide a device of this character that will be simple in construction in which new lengths of floss may be quickly adjusted when required and tightly clamped.

TABLET-MACHINE.—J. V. BRANN, Knoxville, Iowa. Mr. Brann's invention is an improvement in machines for molding and compressing tablets. The machine may be made to manufacture any desired number of tablets at a single operation and is especially suitable for physicians' use, since it may be constructed at small expense and is capable of producing either compressed tablets or tablet triturates.

Prime Movers and Their Accessories.

ENGINE.—A. S. BARNES, Batavia, N. Y. The improvement is in an engine adapted for the use of steam, gas, or other motive agent. The engine comprises a casing, a piston mounted to swing in the arc of the circle in the casing, a crank-shaft, a connection between the piston and crank-shaft, an inlet-pipe for a motive agent, a valve for controlling the inlet, a cam on the crank-shaft for operating the valve in one direction, an exhaust-pipe, a valve for the exhaust-pipe, a cam on the crank-shaft for moving the valve in one direction, and a pipe leading from the exhaust into the upper portion of the casing.

ASH-PAN FOR LOCOMOTIVES.—C. G. ECKENRODE and N. BALDWIN, Pierre, S. D. The invention has reference to an improved construction in ash-pans for locomotives whereby the pan may be dumped at any time by the movement of a single lever within easy reach upon the cab. The ashes may be dumped from the pan in a few seconds without the fireman leaving the cab or climbing to any dangerous position.

Railways and Their Accessories.

AIR-BRAKE ATTACHMENT.—G. EMERY, Argenta, Ark. Primarily the object of the inventor is to so construct the usual angle-cocks applied to the train-lines in air-brake systems that should the cock be accidentally, maliciously, or otherwise closed during operation of the train the engineer will be instantly informed, thus avoiding the possibility of the engineer running the train in ignorance of the fact that a part thereof is cut off from the brake control.

GRAIN-DOOR FOR CARS.—E. SCHREIBER, Atchison, Kan. The door is such as is used on freight-cars for preventing the leakage of grain in shipment. The object of the invention is to produce a door which may be easily closed or opened and held out of the way so as to clear the doorway. The purpose more specifically is to produce a door which will be light and admirably adapted to support the pressure of the grain within the car.

Pertaining to Recreation.

FISHING-REEL.—T. V. BUCKWALTER, Altoona, Pa. The object of the invention is to provide a reel of simple and strong construction and which permits the strain in winding the line upon the spool to be exerted in the plane of the longitudinal axis of the rod, and thus obviates a distortion of the same in the hand of the operator.

HAMMOCK.—E. F. PILLMAN, Boston, Mass. One object of the invention is to provide a frame on the order of a tripod and which occupies a substantially horizontal position in use above the hammock, which frame is provided with means for connecting it with the back and the front portions of the hammock and also with an overhead support.

GEAR FOR MERRY-GO-ROUNDS.—W. F. MANGELS, New York, N. Y. The object in this instance is to provide a gear arranged to accommodate any desired number of crank-shafts and to drive the same directly and at the same time from the main gear-wheel, thus obviating all compounding of the gear and rendering the merry-go-round simpler and more durable in construction and effective in operation.

PUZZLE.—W. J. BYCRAFT, Ashtabula, Ohio. The object in this case is to provide a simple and durable puzzle or game which is of sufficient difficulty of performance to necessitate some skill and practice, which can be used as a puzzle by an individual or as a game by two or more, and which is easy and inexpensive to manufacture.

FISHING-FLOAT.—W. S. PETTIS, JR., Pass Christian, Miss. The invention resides in the peculiar form of detachable ring arranged on the quills of the float for attaching it to the fishing-line, and consists in forming the attaching-ring of helicut coils of wire having an intermediate convolution thereof bent into loops or clamping form adapting the ring to be fastened on the line and carried thereby ready to be slipped on the float quills, effecting connection of the upper and lower ends of the float in desired adjustment on the line.

Pertaining to Vehicles.

VEHICLE-COVER. — E. L. WESTBROOKE, Jonesboro, Ark. The object of the invention is to produce a cover properly supported and suspended from above the vehicle and capable of being dropped down around it and protect it from dust and at the same time is light enough to be readily drawn up from the vehicle when it is desired to use the latter. It is desirable as a protector from dust for automobile carriages, surreys, and the like.

DEVICE FOR RETARDING THE REBOUNDING ACTION OF SPRINGS.—A. C. WALLING, Belleville, N. J. The object of the invention is to provide a device for preventing or retarding sudden rebounding action of springs in the space between the axle and the body or frame of the vehicle to insure easy riding to the occupants of the vehicle and without danger of the occupants being unduly jolted or unseated when the vehicle passes over deep gutters or over stones and other obstructions.

NECK-YOKE ATTACHMENT.—D. N. LUSE, Carroll, Iowa. Many accidents are caused by poles dropping, and thousands are annually killed or crippled by the use of unsafe neck-yoke centers, and the safety feature of this device is therefore of great importance. The safety-stirrup being in the rear of and engaging with an eccentric flange will prevent the pole-section from becoming displaced, and will hold same securely on the pole-tip without interfering with any of the desired movements of the pole-section, the stirrup forming a safety device which catches behind the flange on the pole-tip and securely braced by a brace-loop. The yoke is turned one-half round in order to be placed on and removed from the tip.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

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(10386) E. O. H. asks: Will you kindly inform me what composition pulp or fiber water pails, tubs, and trays are made of? Also kindly explain how they are formed or pressed. A. Old paper stock is boiled to a pulp with water. It is then pressed to remove the excess of water and mixed with glue, gum dextrine, starch paste, or rosin size and pressed into oiled molds under heavy pressure. Dry. Then soak with linseed oil and dry with heat. It is usual to add some mineral weighting material to the pulp, such as clay, chalk, barytes, etc.

(10387) F. R. J. asks: How should paper to be treated (manila or wood pulp or straw paper) to prevent mold when placed on damp or moist surface? A. Any antiseptic chemical can be used; as these are all poisonous, paper so treated must not come in contact with edibles. Bichloride of mercury, sodium fluoride, carbolic acid, salicylic acid, or benzoic acid are a few of such chemicals. The essential oils are also very good, and would not be poisonous to any extent; dissolve in alcohol and flow it over the paper to be treated. Oil of sassafras is one of the cheapest that can be so used. Oiling or paraffining the paper will also serve.

(10388) B. J. L. asks how to digest old rubber. A. Place the material, cut in small shreds, in a strong (boiler iron) air-tight vessel, provided with a good safety valve, and introduce into it 4 or 5 parts of bisulphide of carbon for each part (by weight) of rubber. Close all the openings, and place the vessel over a suitable water bath or, what is better, have a small steam coil inserted within the boiler. Heat for an hour at the boiling point of water. This will insure the complete solution of the rubber. The vapor of the bisulphide is very inflammable; and when mixed with air, it is explosive when ignited. For these reasons, as well as because of the offensive odor of the solvent, the operation is best conducted in the open air, and with steam heat only.

(10389) E. E. S. desires a method of identifying the element rhodium, also its chemical reactions, which would enable one to test ores for the presence of the above-named substance. A. The separation and detection of rhodium is difficult and requires expert chemical work; it would be impossible to give any simple method of detection, as it is always associated with other metals of the platinum group. There is no book published devoted to the analysis and separation of the rare earths. The information must be obtained by consulting the various standard works on chemical analysis and by looking through the journal literature. Fresenius' "Qualitative Analysis" gives considerable information as to rhodium, as well as on the other rare metals.

(10390) J. W. W. wishes to know what is best for a mold to burn a substance at a red heat that will not crack or give? Have tried wrought iron. Cast sometimes gives or bends. How would fire clay or the same composition as Berlin crucible do? Can you give me a formula for it? A. Fire clay, mixed with some molder's sand, or kaolin, can be used for making such molds. If mixed with stale beer or ale, it gives a firmer mold than if mixed with water. Phosphate of lime, also mixed with stale beer, gives a very clean, white mold, but is not strong. Thoroughly dry and bake before using.

(10391) R. M. L. asks how to preserve flowers. A. 1. A method of preserving the natural colors of flowers, recommended by R. Hegler in the Deutsche Botanische Monatshefte, consists in dusting salicylic acid on the plants as they lie in the press, and removing it again with a brush when the flowers are dry. Red colors in particular are well preserved by this agent. Another method of applying the same preservative is to use a solution of 1 part of salicylic acid in 14 of alcohol by means of blotting paper or cotton wool soaked in it and placed above and below the flowers. Powdered boracic acid yields nearly as good results. Dr. Schonland, in the Gardener's Chronicle, recommends, as an improvement in the method of using sulphurous acid for preserving the color, that in the case of delicate flowers they might be placed loosely between sheets of vegetable parchment before immersion in the liquid, so as to preserve their natural form. 2. Insert their stems in water in which 25 grains ammonium chloride (sal ammoniac) have been dissolved. Flowers can be preserved in this way for fifteen to thirty days. To preserve them permanently for several months dip them into perfectly limpid gum water and then allow them to drain. The gum forms a complete coating on the stems and petals, and preserves their shape and color long after they have become dry.

(10392) C. N. asks how to join or weld tortoise shell. A. 1. Bring the edges of the pieces of shell to fit each other, observing to give the same inclination of grain to each; then secure them in a piece of paper, and place them between hot irons or pincers; apply pressure, and let them cool. The heat must not be so great as to burn the shell; therefore try it first on a white piece of paper. 2. Small pieces of good tortoise shell may be joined so as to form one large, apparently seamless piece in the following manner: Slope off the margins of the shells for a distance of about one-quarter of an inch from the edge. Then place them so that the margins overlap one another; and thus arranged put them in an iron press and immerse in boiling water for some time. The pieces by this means become so perfectly united that the joints cannot be seen. The filings and very small scraps may be softened in hot water and consolidated by hydraulic pressure in metal molds. Protracted heating of the tortoise shell darkens it, and greatly lessens its beauty.

(10393) R. J. asks: Can you kindly advise us as to the best means of oxidizing yellow and red brass (in castings or in rolled sheets) copper and bronze. We have several showcases, the metal trimmings of which are backed with wood, rendering it impossible to heat same sufficient to oxidize in the usual manner. A. If the blackening effect is the one desired (and this is what is known as "oxidizing" in the trade) it can be obtained by using a very dilute solution of potassium sulphide, to which sometimes a little ammonium sulphate is added. As the article itself cannot be heated, it will be well to heat the solution of potassium sulphide.

(10394) F. T. H. asks: Will you kindly inform me what is the common practice in writing the past participle of the verb to *arc*, a term which I believe is common in electricity? Is this spelled *arced* or *arcked*? Also, what is the practice regarding the spelling of the past participle of the verb *shellac*? Should this be spelled *shellacked* or *shellaced*? A. The word "shellac" is spelled both with and without a

k. As a verb its past participle is always spelled with the *k, shellacked.* If spelled *shellaced,* it must be pronounced with a soft sound of the *c,* as in the word *laced,* which is not admissible. When the word *arc* as a verb shall find a place in the dictionaries, it would seem that it must be treated in a similar manner, and have the *k* inserted in its past forms, and for a similar reason.

(10395) J. P. says: Please give a recipe for a cement that will fasten unglazed porcelain to iron. A. 1. Melt carpenter's glue in wine vinegar, add a little Venice turpentine and boil up for half a day over a slow fire. 2. Mix 15 parts copal varnish, 5 parts drying oil, 5 parts turpentine, and 5 parts liquefied glue, and set in boiling water until all are melted together. Then stir in 10 parts of slaked lime. Use immediately.

(10396) W. H. T. asks: How is gas made from water? Is there a book that would enable a foundry foreman to learn how to make an analysis of the iron in his castings? A. Briefly described, water gas is produced by blowing steam through a layer of brightly glowing coal; the water is decomposed, and the coal is consumed; the gases coming off are a mixture of hydrogen, carbon monoxide, and hydrocarbons, with small amount of carbonic dioxide, and variable amount of nitrogen. When the coal cools off too far to further decompose the water vapor, this is shut off, and air is blown through until the coal again burns brightly and is ready for more steam. While the air is blown in, the gases are allowed to escape up the chimney, as they have no value as illuminant, and in fact would not burn at all. The water gas as it comes from the producer has very little illuminating power. This is imparted to it by enriching with benzine. There is no book which would explain to anyone not a chemist how to determine the amount of iron in brass or other castings. Such work must be done by a chemist. All books on analytical chemistry of the metals describe methods for this, but would be unintelligible to any person except a regular chemist.

(10397) R. G. P. asks: Are there any chime music boxes with a set of bells on them? How does the name chime get its name? A. The word chime comes from a Latin word, meaning bell, and also cymbal. Music boxes are made with sets of bells in them.

(10398) E. G. P. asks: How can a scratch be removed from the top of an oak table (highly polished)? A. If the scratch is only a slight, superficial one, it can usually be removed by rubbing with a rag soaked with crude oil. If a deep scratch, it will be best to rub down the whole top of the table with powdered pumice and crude oil, and then revarnish.

(10399) G. P. O. wishes a process for galvanizing such as is done on the base boards for stoves. A. The article to be galvanized is first thoroughly cleaned by dipping in weak muriatic or sulphuric acid, and is then thoroughly dried. After this it is plunged in a bath of molten zinc, wherein it becomes coated with a layer of zinc, being what is known as galvanized. The surface of the molten zinc must be kept clean by sprinkling with powdered sal ammoniac and skimming off the dross from time to time.

(10400) G. G. G. asks: How can I gild or marble edges of books, to resemble as nearly as possible those gilded by publishers? A. To gild the edges of books, they are first trimmed smooth, then sized with egg albumen (white of egg) and gold leaf then applied. When dry it is burnished with agate burnisher. For mottling, a very thin solution of gum arabic is prepared in a tray, and the different colors are then shaken in or combed in. A half dozen or so of the books are held securely and evenly together, and the top, bottom and front edges are successively dipped in lightly, and the excess of color is each time blown off. Successful marbling is quite expert work.

(10401) W. J. D. asks: 1. Is there any method by which soft coal can be made into brick or lump form by mixing with other substances or by itself? A. The powdered or crushed soft coal can be pressed into bricks and then be partially coked to give strength. If the coal alone will not adhere sufficiently well on pressure, it can be mixed with pitch, and then partially coked. 2. Can the ordinary 150 deg. test kerosene oil be clarified to prevent the strong smell while burning in a lamp or wick oil stove? A. A good quality of kerosene will not give much odor in burning in a lamp or wick oil stove, if care be taken to keep the wick well trimmed, and to adjust so that it will burn without smoke. There is no way to further purify kerosene oil, as to make it burn without odor.

(10402) W. H. A. asks: 1. Does the process of steaming wood in any manner destroy the life of wood, and are there any limits to this destruction? A. The steaming of wood for bending purposes seems to do no injury, as the lasting quality of wood so treated is very evident in our old ships and bent wood in agricultural implements. 2. In small-boat construction is there any special process for steaming wood (pine or oak)? A. The universal practice is simply a wooden steam box connected to a closed kettle of water over a fire. 3. If there is a destruction of the vitality of woods, would there be a way of lessening this effect? A. Even the steam boxes in use for many years retain vitality and strength in the wood to a surprising extent. We know of no needed improvement.

(10403) C. H. H. says: I wish to use my gasoline car during cold weather. Kindly tell me whether chloride of lime, added to the water used to absorb heat from the cylinders, will prevent the water from freezing when the machine is not in use, and the water is cold. What proportion of chloride of calcium should I use? What weight per gallon of water? A. Chloride of calcium (not chloride of lime) can be used to lower the freezing point of water. All dissolved salts tend to corrode metal more quickly than pure water, hence care should be taken to clean up occasionally so as to prevent corrosion.

(10404) H. E. H. wishes the exact number of pounds (16 ounces) a cubic foot of hydrogen gas will raise. A. One thousand cubic feet of hydrogen weighs 75 pounds less than 1,000 cubic feet of air at normal pressure and at the freezing point of water. It is customary to allow 70 pounds as the lifting power of 1,000 feet of hydrogen in a balloon, the difference being to provide for some advantage on the part of the hydrogen. It would balance 75 pounds, but lift 70 pounds with case.

(10405) W. A. H. G. asks: 1. Can a plain slide valve steam engine be run by compressed (hot) air, or must the valves or packing be changed? A. Any engine that is suitable for steam is equally suitable for compressed air. 2. When air is compressed to one-fourth its volume, would it have four times the pressure (60 pounds per square inch)? Immediately after the air is compressed, its temperature will be quite high. After cooling, how much would the pressure decrease? A. Air compressed to one-fourth its volume without loss of heat will have a pressure of 89 pounds per square inch, or 60 pounds without heat, isothermal.

(10406) W. H. D. asks: 1. Is the hot flame from a needle hole through which passes the hot gases of vaporized kerosene a "boring" flame, as common gas is held to be, even on iron? A. All vapor gas jets when made to impinge on any body that will burn by heat may be said to be a boring flame. 2. If it is not a boring flame, is it advisable to apply it, in the firepot of a furnace, directly to the sides of the firepot to heat water or generate steam for house heating? A. A jet flame of any kind should not impinge directly upon a firepot, but directed around it. 3. If it is a boring flame, how can it be applied most economically for such heating? A. By jetting the flame around the firepot in a chamber of firebrick. 4. How can this fuel and flame be applied most economically to furnaces heating by hot air? A. By jetting the flame against a firebrick surface in the fire chamber. 5. We were much interested in your article on oil burners, but you did not give the furnace phase of the question. It will interest thousands of your readers. What burners are best adapted for such? A. There are a number of oil burners on the market which must be operated by steam or air pressure. 6. I have looked through shelf after shelf of engineering works, yet find no tabular schedule of atmospheric pressure, barometric height, altitude and boiling temperature. A. "Compressed Air and Its Applications," by Hiscox, contains a full table of barometric heights and boiling temperature of water (page 38); $5 by mail. 7. As pressure exceeds normal, is the temperature of water the same as the steam? A. Yes. 8. When the steam gage shows pressure of 1 pound, does it not mean 1 pound *above atmospheric*? A. Yes. 9. According to all formulæ of heating, it seems to me a mathematical certainty that shutting off radiators in unused apartments economizes fuel in just the ratio of such cubic space or radiating surface. Yet I find men who contend there is no economy. My experience is in accordance with my belief and formulæ. A. Our experience is in the line of economy from closing radiators when not needed.

(10407) O. L. C. writes: Please see Not 7 and Queries 10342. If reasoning there is correct, a hollow paper globe filled with hydrogen will fall as fast as a solid leaden sphere. The work-power to accelerate velocity and remove air depends on weight of body only. Since the resistance is the same, and the weight, therefore work-power, of lighter body is less, it must fall slower. The SCIENTIFIC AMERICAN is valuable, but not infallible. A. It is so evident that the answer to Query 10342 is incomplete that it is also surprising to receive so many criticisms on the matter. It is only necessary to say that the difference between free fall and a fall against the resistance of the air is not apparent for balls of lead and aluminium until a fall of about 100 feet is reached. Our authority for the statement is Mayer's "Mechanics," page 33. For all falls through short distances, the answer to which objection is made is practically correct. We, however, cheerfully admit that we are not infallible. not so infallible as our critics.

(10408) C. H. W. writes: I have for many years been reading with much pleasure and profit your answers to the varied questions that are addressed to you, and have learned to rely on them fully. Great is my surprise, therefore, to read, in Query 10342, your statement that "the two spheres of the same size" [but of different weights] "will fall through a given height in the same time." It would be easy to show, mathematically, the falsity of this conclusion, but a more direct way would be a resort to experiment. If your principle holds good, a toy balloon, or even a soap bubble, would reach the earth from a given height at the same time as say a croquet ball of the same size. Try it. Or, if you prefer a rather more elegant experiment, make two pendulums of the same length with spherical bobs of just the same size, but one of wood and the other of lead, and start them swinging together and see if they will finally come to rest at the same time, as they should do on your theory. But enough; excuse my friendly criticism. A. The answer to Query 10342, to which your letter refers, by some oversight was inserted without the qualifying statement as to what height two metal balls may be dropped without separating perceptibly in their fall. It is stated by Mayer to be about 200 feet. See his "Principles of Elementary Mechanics," page 33, at foot of page. Your confidence in us might have led you to say that something had been omitted rather than to charge an error so swiftly. We have had much experience in teaching physics for nearly forty years, and are still in the harness. What you say about a soap bubble is hardly to the point. Lead and aluminium are more nearly alike in density than are lead and air. Dense metallic balls do not deviate from free fall perceptibly for quite a distance, say 100 to 200 feet. See Mayer as above. This question has been up many times. It seems to be always up. The literature of it in our query column is quite extensive. See Queries 9679, 9756, 9804, 9840, 9873, 9879. There have been others, but we do not have the references just now. These are within two years.

(10409) E. L. C. asks: 1. If a vessel sinks in five miles of water, will she go to the bottom? If not, why? I think she will; the others think not. A. If a vessel begins to sink, it must continue to sink till it reaches the bottom. If it is compressed by the pressure of the water as it goes down deeper and deeper, it becomes still heavier with reference to the water than it was at the surface, and at the surface it was heavy enough to sink. At greater depths it will be able to sink faster, since the water is not compressed to any extent at greater depths than it is near the surface. If anything can sink at all in water, it will go to the bottom before it stops. 2. If a man gets into a tank of water resting upon a pair of scales, and floats upon the water, will the scales register the man's exact weight in addition to the weight of the tank and water? Will it make any difference whether he floats or lets himself sink? The tank sides are high enough, so that no water can overflow. A. The balances will show the weight of the man in addition to the weight of the tank and the water. When the man gets into the water, the water rises in the tank; that is, it becomes deeper. It is exactly the same as if more water were poured into the tank. No one would doubt that the scales would show more weight if 100 pounds of water were put into the tank. Why not when 100 pounds of man are put in? This question has traveled for a century in various forms around the world.

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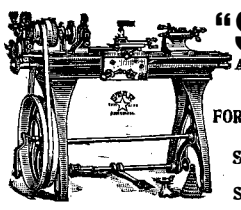

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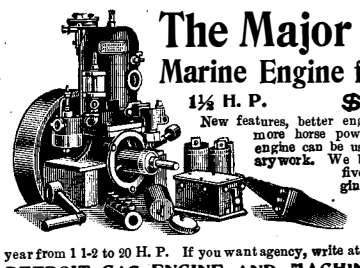

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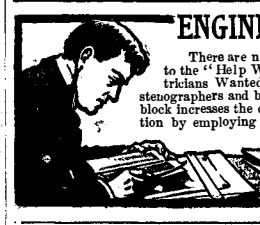

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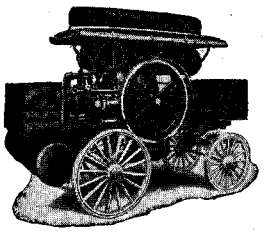

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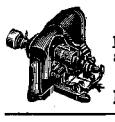

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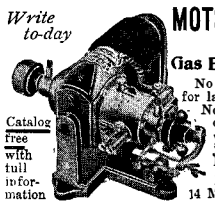

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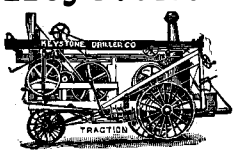

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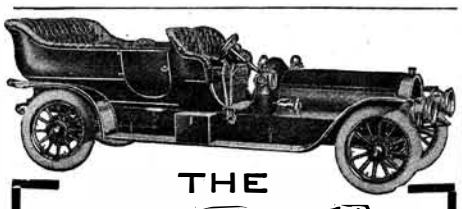

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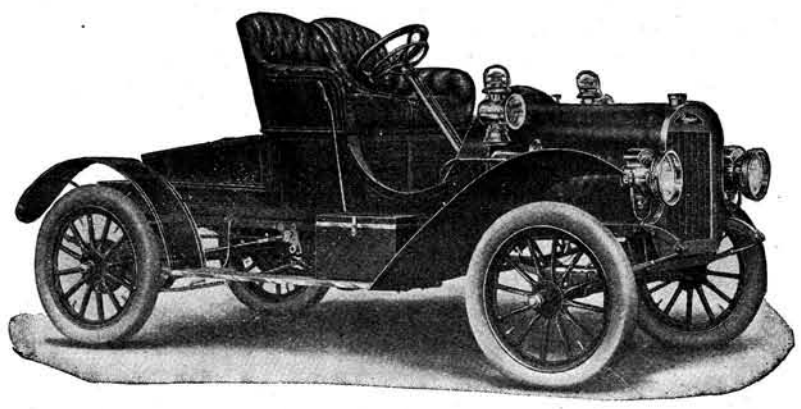

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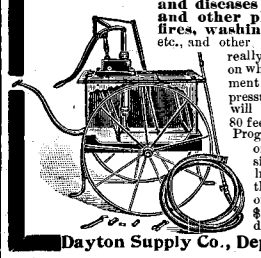

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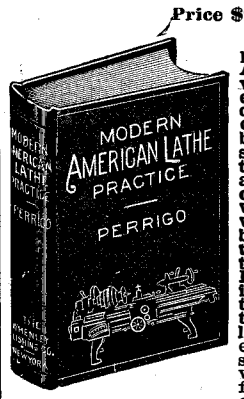

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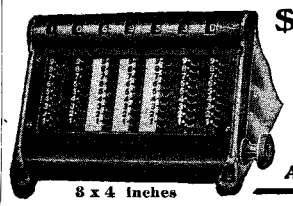

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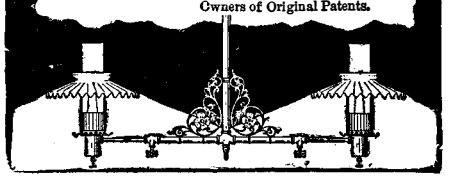

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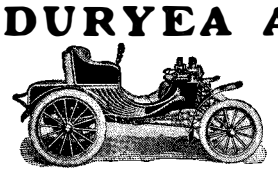

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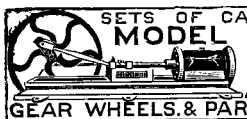

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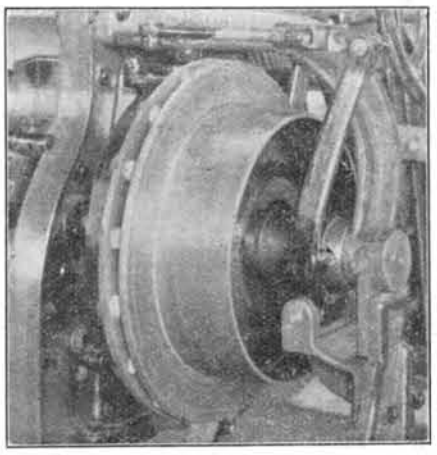

THE REASON

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WHY THE CROMPTON & KNOWLES LOOM WORKS of Worcester, Mass. (licensee), is shipping more than 100 looms so equipped, per month,

WHY THE AMOSKEAG MFG. CO. (licensee) is rapidly equipping its Worrall clutches and loom clutches with **Cork Inserts,**

WHY Cork Inserts should be used in ALL TYPES of power transmitting devices,

WHY licenses already granted to automobile manufacturers insure the use of **Cork Insert** Clutches or Brakes or both on more than ten thousand automobiles in 1907.

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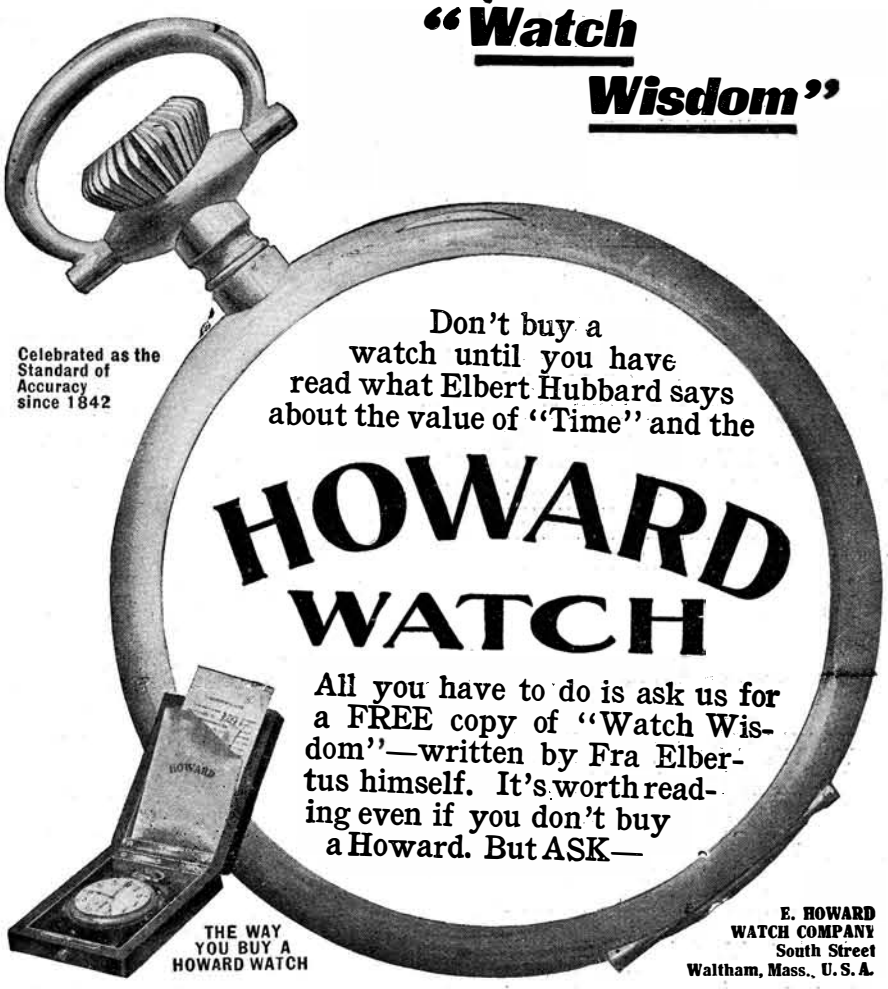
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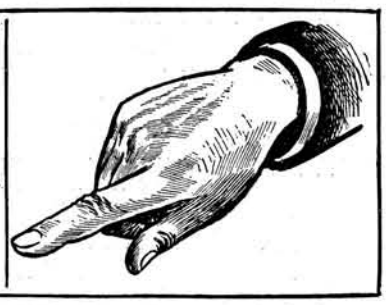

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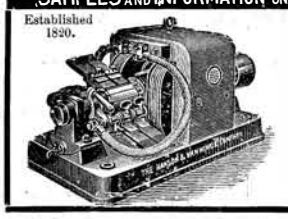

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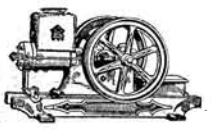

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